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OFFICE OF THE CHIEF OF NAVAL RESEARCH
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Task I Report and Request for Renewal

"Core Scientific Effort for Biosurface Studies"

01 Jun 1989 - 30 Aug 1991

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A. Current Program Status

I. Overview

This report summarizes the results from the first three years of ONR support and direction of the "Core Program" of the I/U Center for Biosurfaces (IUCB) and includes the Center's request for renewal of funding for an additional 3-year period. In the three years of ONR-funded operation of the multi-organization IUCB, all originally proposed components of the program were performed: a "core" research program, "associated" and "affiliated" research projects. Associated projects were funded after ONR and other representatives of the Members Advisory Board (MAB) reviewed and approved using Members funds, within the Membership Agreement. Affiliated projects were smaller projects, funded by State or University sources after similar MAB review. They were meant to seed activities for later consideration for direct funding by the MAB. Funding provided by the New York State Center for Advanced Technology was also used for "core" research activities, while the University's contribution enabled continued attention to technology transfer activities.

State and University funding, along with that from ONR and industry, developed and sustained the base of fundamental research. The IUCB is now attracting industry and university funding for a new group of associated projects recommended at the MAB proposal evaluation meeting held January 29, 1991, and confirmed on June 27, 1991. The originally anticipated funds for affiliated projects have been cut, reflecting New York State's current fiscal problems. The research projects currently recommended for funding are listed in Appendix A to this report.

II. Membership Status

The IUCB has recently completed new research agreements with Bausch and Lomb, Inc. and Becton-Dickinson Corporation, now joining with American Cyanamid, Procter and Gamble, and GIBCO-Life Technologies, as Center Members with the Office of Naval Research (ONR) in support of the Core Program. Nobelpharma USA has indicated that budget problems will prevent its continuance of membership this year. Additional center membership agreements currently are being negotiated with Rich Products Corporation and Union Carbide Corporation.

A new Center Prospectus was issued in August 1990 and has been a valuable document in the solicitation of new members; an updated version of the Prospectus is in preparation for issue in 1992. Our goal is to add at least two new industries to the Members Advisory Board by the end of 1991, bringing membership to eight, and two more Members prior to the Advisory Board meeting of June 1992.

III. Current and Projected Operating Budgets

The IUCB was originally set up to operate with a balance of four sources of income for

the program. The first was Grant NSF CDR #88-17192, providing funding for administration of the program at SUNY Buffalo and for cooperative research at Montana State University, (MSU), with Dr. Keith Cooksey serving as the MSU-based Principal Investigator. While continuing to offer space, overhead waiver, and equipment/facilities assignments, the University awarded funding to the Center in the amount of \$44,707 for 1990-91 (in comparison to \$94,000 in 1989-90) as part of the University's "Organized Research Unit" program. Continuation funding has been requested from the University by the IUCB at the level of \$130,000 for 1991-92 to recoup the current year budget shortfall and replace State funds no longer available through the Center for Advanced Technology program. The third component of funding, a commitment of approximately \$200,000/year for Biosurface Science research from the New York State (NYS) Center for Advanced Technology (CAT) located at the University, was reduced to \$80,000 and added to the ONR-supported "core" program this past year. Renewal of our prior successful program that provided funding (allocated through advice and review by the MAB) for affiliated research related to the IUCB program will be difficult. The University and New York State's Center for Advanced Technology at Buffalo, had both agreed that the MAB's review procedure was an important technology transfer mechanism and met the requirement for industrial relevance. The Center Co-Directors are continuing their efforts to restore this important source of funds.

ONR and other Center members provide the most important component of funding for the IUCB program. In Year 3, membership fees increased to \$200,000 (5 members); add-on projects accounted for an additional \$60,000. The projected total budget for the IUCB for Year 4 (August 15, 1991 to August 15, 1992) is \$729,400. "Core" program support from the NYS CAT allowed for IUCB's continued partial staffing of an instrument center originally equipped at a cost to the State University of New York in excess of \$3,000,000 in 1988-89. The primary budget goals for the next 3 years are expansion of the membership to provide a larger funding base, and restoration of the original funding levels committed from the State and University. As a means of cost cutting for the program's administrative components, and a necessary response to the cut in State support, management responsibility (and personnel) for the major instruments utilized by the Center has been transitioned to the Department of Biomaterials (G.H. Nancollas, Chairman). While this lessens the burden on Center Staff, access to the equipment for projects of the IUCB is maintained because both Center Co-Directors are faculty in the Biomaterials Department.

Projected IUCB Operating Budget, Year 4 (1991-92)

Members (7 @ \$40,000)	280,000
University/State Commitment	150,000
Add-On Projects, Service and Facility	160,160
NSF	99,240
ONR	40,000
TOTAL:	729,400

IV. Other Study Issues

The Center continues to develop plans for a Young Scholars application, International Program and TIE projects with other IUCRC's. The status of these plans is reviewed in working papers collected in Appendix B.

B. Current Research Status

I. Summary of the Research Program

As a result of the MAB review meetings in January and June 1991, continuation of "Core Program" activity and four new projects were recommended for a 12-month period. The MAB, in June 1991, did recommend changes in emphasis and acceleration of the cell biology and bacterial adhesion aspects of the ongoing and new projects. An overview of the collective program is given in Figure 1 (Gantt Chart). Current research abstracts and brief biographical sketches of the principal investigators are included in Appendix A:

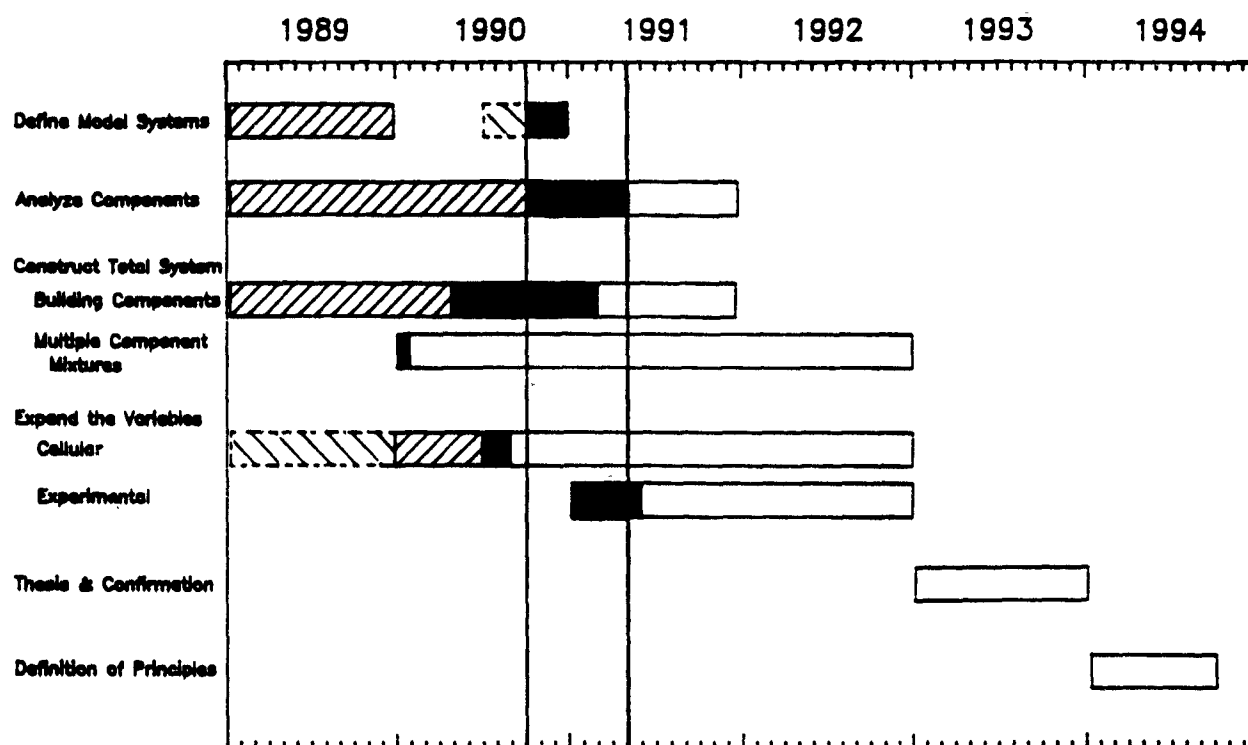
Dr. Frank Bright (Department of Chemistry) - Quantification of Protein Sorption and Desorption at Interfaces Under Ambient Conditions;

Dr. Joseph Gardella, Jr., (Department of Chemistry and Department of Biomaterials) - Ultra-High Vacuum Surface Analysis of Model Organic and Biological Films on Solid Substrata;

Dr. George Nancollas (Department of Biomaterials and Department of Chemistry) - Mineralization and Dissolution Kinetics Studies at Plasma- Sprayed Implant, Ceramic and Immobilized Macromolecular Surfaces;

Dr. Robert Baier (IUCB; Department of Biomaterials and Department of Biophysical Sciences) - Substratum-Induced "Conditioning" Film Changes as Revealed by Thin-Layer Immunoassay;

Dr. Keith Cooksey's project, conducted at Montana State University over the past year,



PROGRESS MADE ON IUCB'S RESEARCH PROGRAM

- Heavy black vertical lines indicate the time frame of new project efforts described in Appendix A
- Black areas show the actual progress during this same period
- Right-hand crosshatch shows the extent of progress made on originally proposed tasks
- Left-hand crosshatch shows the extent of additional progress made, not part of original proposal
- White boxes indicate studies yet to be accomplished; original plan

was given a no-cost extension by the MAB; this project is entitled "A Study of Adhesion of Fouling Diatoms to Surfaces of Defined Composition Including an Examination of the Source and Role of the Conditioning Film." NSF funds earmarked for Montana State University were awarded to Dr. Gordon McFeters (Department of Microbiology) in the current year, to study the physiological status of bacteria in biofilms. The Montana State University relationship is further described in Appendix B. Although the Members Advisory Board still has this collaborative agreement under study, it has suggested an action plan for better integration of the MSU investigators into the Center's program.

Based on the MAB recommendations of a series of shorter-term (4-6 months) projects for funding from New York State's contribution, the Board has recommended continued funding only for the project of Dr. John Campbell - The Response of Normal and Carcinoma Cells to Implantable Biomaterials, augmented by additional studies to be led by Dr. Anne Meyer, as Co-Principal Investigator. The Agendas of the June, 1990, January, 1991 and June, 1991 MAB meetings are included as Appendix C.

II. Technical Personnel

In addition to research faculty, the following individuals provided the 1990-91 technical and management foundation of the IUCB:

Robert E. Baier, Co-Director
Joann Earle, Research Support Specialist, Core Program (Transverse Analysis)
Joseph A. Gardella, Jr., Co-Director
Gary L. Jones, Senior Research Support Specialist, Core Program (Planar Analysis)
Anne E. Meyer, Program Manager
Terrence G. Vargo, Post-Doctoral Fellow (High-Vacuum Surface Spectroscopy)

Graduate research students involved in the Center's program are listed in Appendix D., along with their faculty advisors.

The NSF also supported two under-represented (women and minority) undergraduate research students through the IUCB in the past three years. Fred Archer, III, now at Cornell University, is receiving continued NSF support through 1991-92, contributing to both "core program" and "associated project" activities.

C. New and Continued Research Support Request

I. Continued NSF Support of IUCB Program

Base NSF support for 1991-92, in the amount of \$75,000, has been requested and received for continuation of the joint program between the Buffalo and Montana groups. In addition, NSF has agreed to support an affiliated Research in Undergraduate Institutions project on graft polymerization to surfaces, and the minority undergraduate research assistant. A total

budget of \$118,478 has been approved by NSF for 1991-1992.

II. Continued ONR Support of IUCB Program

As detailed in Appendix H., the Office of Naval Research is requested to extend Task I funding of the current grant for an additional period of 3-years, at an annual budget of \$40,000/year to support our "Core Scientific Efforts for Biosurface Studies".

Appendix A. Current Research Abstracts and Faculty Biographical Sketches

I/U Center for Biosurfaces Core Program

The focus of the I/U Center for Biosurfaces' research program is on understanding, prediction, and control of biological adhesion. Multidisciplinary studies of the mechanistic details (including physico-chemistry, biochemistry, and biophysics) of "conditioning" film formation, biopolymer deposition, and cell and protein adhesion to synthetic materials and model tissues are in progress.

The Core Program has both service and scientific elements. Service aspects include data collection and distribution for all collaborating researchers, as well as acquisition, fabrication into useful specimens, and characterization (in advance) of the selected substrata that are used in all associated projects. These specimens are provided to the faculty teams, and to industry researchers affiliated with the IUCB on request, as needed for particular experiments.

The major scientific thrust of the Core Program applies the modern array of surface physical/chemical analytical tools available to the program for the qualitative and quantitative description of complex, primary organic layers acquired by the substrata. At various stages in the exposures of substrata to relevant biological systems by project teams, the Core Program also provides surface characterization of the biosystem-modified specimens and the "conditioning" films or overlayers they retain.

Current milestones of the program are to complete characterization of seven candidate substratum materials, with special emphasis on establishing baseline levels of impurities, cleaning procedures, and, where appropriate, developing means for sterilization; develop methods for minimizing sample disruption during cross sectioning procedures, establish a consistent source of synthetic hydroxyapatite; optimize methods to qualify and ensure the quality of model film components.

Substratum-Induced "Conditioning" Film Changes as Revealed by Thin-Layer Immunoassay

R. E. Baier and A. E. Meyer

Department of Biomaterials and Biophysical Sciences

The objectives for the 1991-92 year are, in concert with the IUCB 5-year plan, to expand the variables of the assays to include more biologically specific probes of the expression of particular "conditioning" film epitopes. The experimental plan anticipates the use of anti-albumin, anti-globulin, anti-fibrinogen and anti-betalactoglobulin against spontaneously adsorbed thin films of the primary protein antigens on well-characterized reference substrata. There also will be the production of specific, tailored substrata (octadecyl amine, alcohol, and acid monolayers from both Langmuir-Blodgett transfer and the "retraction" process) for examination of the competing hypotheses of dipole- or charge-based "action at a distance", hydrophobic/hydrophilic ratio, and surface free energy as the major influences on specific bioadhesion. Particular emphasis will be given to the possible expression of "cryptitopes" (previously hidden functional sites) as a consequence of substratum-induced protein conformational changes. Polarized, internal reflection infrared analyses will be attempted to obtain these data directly, and collaboration will be sought with IUCB "core program"

investigators using both specific staining and high vacuum analytical instrumental approaches for functional group identification.

Quantification of Protein Sorption/Desorption at Interfaces Under Ambient Conditions

F. V. Bright
Department of Chemistry

Over the next year, there will be fuller documentation of the details of β -lactoglobulin (BL) adsorption and desorption at polar and apolar fused-silica interfaces. Specifically, the project will focus on 1) improving understanding of the mechanism of STATIC adsorption; 2) elucidating the kinetics and mechanism of the corresponding STATIC desorption; 3) determining the effects of FLOW on items 1 and 2; and 4) quantifying these same processes (items 1-3) at modified silica surfaces (e.g., silanized, alkylated, and polymer (PMMA, PDMS) coated). To this end, the intrinsic tryptophan fluorescence from BL will be used to report the extent of conformational changes in the BL at interfaces, with time. In addition, efforts will continue on determining the actual rotational (precessional, more accurately) motions of BL (and other proteins) at these same interfaces.

Cellular Response to Metals, Polymers and Ceramics

J. H. Campbell and A. E. Meyer
Department of Otolaryngology and Biophysical Sciences

This investigation will expand previous studies to include reference samples of commercially pure titanium, 316L stainless steel, poly-L-lactide, polystyrene, polydimethylsiloxane, and hydroxyapatite from the "core program". All materials will be cleaned and sterilized in accord with protocols recommended by the "core program". Cellular growth effects of each material will be assessed for sequentially passaged chinese hamster ovary (CHO) fibroblasts for primary cultures of human skin, human mucosal epithelial cells, and human epithelial tumor cells. Methodology will include extract and direct contact assays, as well as chemotactic assays employing modified Boyden chambers. An attempt will be made to block growth effects by cation chelation, antibodies to specific substances, or other appropriate means. Inductively coupled argon plasma (ICAP) spectroscopy of biomaterial extracts will be employed to quantitate material dissolution. Scanning Electron Microscopy (SEM) and light microscopic photography will be utilized to document project findings.

A Study of Adhesion of Fouling Diatoms to Surface of Defined Composition Including an Examination of the Source and Role of the Conditioning Film

K. E. Cooksey

Department of Microbiology, Montana State University

The goals of this project are to determine which physico-chemical properties of a surface govern the strength and extent of adhesion of diatoms, and to examine how the extracellular polymer produced by diatoms is able to modify clean surfaces such that their properties as potential bioadhesive substrata are changed. Adhesion assays will use washing procedures with differing shear forces, so that different levels of strength can be measured. Motility assays will use a video-recording system fitted with a time-signal generator.

Ultrahigh Vacuum Surface Analysis of Model Organic and Biological Films on Solid Substrata

J. A. Gardella, Jr.

Department of Chemistry and Biomaterials

The focus of this project is the determination of structure and reactivity of the substratum and model biofilms. The program will expand variables and develop the ability to probe mixtures of biofilms. In particular, the variables to be expanded include new substrata, new treatments to the substrata and most importantly, the means by which biofilms are deposited. Collaboration with the Baier/Meyer group, which provides the biofilm deposition by Langmuir-Blodgett or (in our own laboratory) static solution deposition, will continue.

Polystyrene (PS) The planned work for the year includes following the structure and reactivity of fibrinogen and betalactoglobulin (blg) films (LB/flow) on RFGD-hydrolyzed PS. In addition, it is planned to follow successful studies on RFGD hydrolyzed fluoropolymers by controlled monolayer silanization procedures with amino propyl tri ethoxy silane (APTES).

Poly lactide The major emphasis in this study is to follow the kinetics of surface hydrolysis with SIMS and ESCA under a variety of conditions. The conditions under study primarily will involve solution, LB and flow-deposited blg at the monolayer level. **Stainless Steel (SS)** With an active (mostly) chromium oxide surface, the SS/biofilm interface may react in two ways. First, the biofilm can oxidize and degrade as it is in contact with a reactive oxide. Second, corrosion of the SS may occur in contact with sea water. In order to model this, accelerated (under electrochemical control) and static exposure of SS to a solution of sea salt will be studied.

Titanium Synthesis and characterization of titanium peroxide at the surface of CP Ti coupons, has been accomplished. Whether such a peroxide can be formed with RFGD treatments (using hydrogen peroxide vapor, a patented sterilizing technique) is now under study. Finally, the oxidation of blg layers on the peroxide is being studied with ESCA and infrared spectroscopy.

The Physiological Activity of Bacteria in Biofilms

G. A. McFeters

Department of Microbiology, Montana State University

The experimental plan for this project includes studies to refine previous work with chlorine, repeating those experiments using another disinfectant and starting to examine the physiological activity of bacteria within biofilms. The specific objectives are to, (1) further improve disinfection with chlorine using a lower pH, (2) use a new approach and experimental system to determine *in situ* disinfection kinetics using monochloramine with surface-associated versus planktonic bacteria and (3) start to characterize the comparative physiological activity of attached and planktonic bacteria using cellular processes such as respiration and RNA synthesis.

Mineralization and Dissolution Kinetics Studies at Plasma-Sprayed Implant, Ceramic and Immobilized Macromolecular Surfaces

G. H. Nancollas

Department of Chemistry and Biomaterials

The influence of glow-discharge and other treatments on the dissolution and remineralization profiles of synthetic calcium phosphate ceramic hydroxyapatite (HA) and plasma-coated implant surfaces will be investigated by constant composition (CC) methods. The P.I.'s experience with the physical chemistry of ion exchange at oxide surfaces will be utilized to study the mineralization of titania which will be pretreated with lattice ions as well as molecular species which will be expected to influence calcium phosphate mineralization activity. The studies will be extended to media containing blood serum components to investigate the ability of proteins and other macromolecules to modify the mineralization reaction kinetics. Flow-through mineralization CC studies also will be made of immobilized protein and polypeptide surfaces in an effort to determine the nature of the calcium phosphate precursor phases. Polypeptides will be synthesized having amino acid sequences identical to fragments of the protein molecules.

Robert E. Baier

Research Professor, Biophysical Sciences
Associate Professor, Biomaterials

10/31/39

EDUCATION

Cleveland State University	BES	1962	Engineering Science
University at Buffalo	PhD	1966	Biophysics

RESEARCH AND PROFESSIONAL EXPERIENCE

Associate Professor, Biomaterials, Faculty of Health Sciences, State University of New York at Buffalo, 1990-present

Director, New York State Center for Advanced Technology, Health-care Instruments and Devices Institute (HIDI), State University of New York at Buffalo, 1985-89.

Research Professor, Biophysical Sciences, School of Medicine and Biomedical Sciences, State University of New York at Buffalo, 1983-Present.

Staff Scientist, Advanced Technology Center, Arvin/Calspan (formerly Cornell Aeronautical Laboratory of Cornell University), Buffalo, NY, 1968-84.

Research Chemist, U.S. Naval Research Laboratory, Washington, DC, 1966-68.

Award for Innovation in Medical Devices (International Competition, peer-jury, \$50,000 prize donated by Pfizer Hospital Products Corporation), through American Society for Artificial Internal Organs, 1987.

Distinguished Service Award, jointly presented by Society for Applied Spectroscopy and Western New York Section, American Chemical Society (Analytical Division), 1987.

Clemson Award for Basic Research; National Award of Society for Biomaterials, 1983.

Society of the Sigma Xi (Cornell University Chapter), elected 1972.

Diplomate, American Academy of Environmental Engineers, 1971.

Union Carbide Chemicals Prize, National Award of American Chemical Society, 1971.

New York Academy of Sciences, elected 1969.

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Joseph A. Gardella, Jr.

Associate Professor, Chemistry
and Biomaterials

08/22/55

EDUCATION

Oakland University	BS	1977	Chemistry
Oakland University	BA	1977	Philosophy
University of Pittsburgh	PhD	1981	Analytical Chemistry

RESEARCH AND PROFESSIONAL EXPERIENCE

Associate Professor, Biomaterials Department, State University of New York at Buffalo, 1991-present

Associate Professor, Chemistry Department, State University of New York at Buffalo, 1987-Present.

Research Assistant Professor, Stomatology and Interdisciplinary Sciences, School of Dental Medicine, State University of New York at Buffalo, 1987-Present.

Senior Member, Undergraduate College, State University of New York at Buffalo, 1988-Present.

Associate Director, Surface Science Center, State University of New York at Buffalo, 1985-1989.

Assistant Professor, Chemistry Department, State University of New York at Buffalo, 1982-87.

Faculty Intern, Chemistry Department, University of Utah, 1981-82.

Research Assistant, Surface Analysis Group, University of Pittsburgh, 1977-81.

Lawrence M. Gelb Foundation Fellow, Bristol Myers Corporation, 1986-89.

Exxon Educational Foundation Fellow, 1989-1991.

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Anne E. Meyer

Principal Research Scientist
Research Foundation of the State University of New York

12/04/51

Research Assistant Professor, Biophysical Sciences

EDUCATION

SUNY at Potsdam	BA	1973	Chemistry
Ohio State University	Cert. Instr.	1974	Labanotation
University of Lund Malmo, Sweden	PhD	1990	Odontological Sciences (Prosthetics)

RESEARCH AND PROFESSIONAL EXPERIENCE

Program Manager, Industry/University Center for Biosurfaces, 1989-1991

Invited Speaker, "Interface Interactions", Workshop on Infection, American Academy of Orthopaedic Surgeons, Dallas, TX, 1990.

Invited Representative from U.S., International Kilmer Memorial Conference on the Sterilization of Medical Products, Moscow, USSR, 1989.

Associate Director, Center for Advanced Technology in Health-care Instruments and Devices, Buffalo, NY, 1988-89.

Invited Speaker, "Gas Plasma Treatments", Health Industry Manufacturers Association Educational Seminar on "Sterilization in the 1990's", Washington, DC, 1988.

Calspan Advanced Technology Center, Buffalo, NY, 1974-86. (Head, Surface Science Section, 1983-86).

Chairman, Human Subjects Committee, Calspan Corporation, Advanced Technology Center, 1985-1986.

Associate Director, SUNYAB/Surface Science Center, 1985-1989.

Assistant Professor, Lecturer, Stomatology and Interdisciplinary Sciences, State University of New York at Buffalo, 1986-1990.

Technical Committee on Career Awareness Through Occupational Education, New York State Council on Vocational Education, 1988.

Board of Directors, American Heart Association/Western New York Chapter, 1985-88.

Mentor, Action Learning Intern Program, and Seminar Instructor, BOCES (NYS Board of Cooperative Educational Services) Programs for High School Students Planning College Educations in Science and Engineering (Erie, Niagara, Orleans, and Genesee Counties).

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ASSOCIATED FACULTY

NSF - IUCRC FOR BIOSURFACES

Dr. Frank V. Bright, Assistant Professor of Chemistry. Received Ph.D. from Oklahoma State University in Analytical Chemistry (1985) and continued with postdoctoral studies in Analytical Laser Spectroscopy at Indiana University until 1987. Since 1987, on the faculty of SUNY-Buffalo. Research efforts center on 1) instrumentation for chemical analysis; 2) quantifying the interfacial processes occurring at the distal ends of fiber-optic sensors and probes; 3) steady-state and dynamic (time-resolved) fluorescence applied to bioanalytical problems; 4) elucidation of the fundamental processes that govern complexation phenomena in organized media; and 5) improving understanding of solvation in supercritical fluids.

Dr. John H. Campbell, Assistant Professor of Oral and Maxillofacial Surgery. Received D.D.S. in 1981 from the State University of New York at Buffalo, School of Dental Medicine. In 1986 completed residency program in Oral and Maxillofacial Surgery, University of Rochester, Strong Memorial Hospital. Board Certified Oral Surgeon. Research focuses on the in vitro effects of metals, polymers and ceramics on cells from normal populations and carcinomas.

Dr. Keith E. Cooksey, Professor of Microbiology and Biochemistry, Montana State University. Received Ph.D. in 1959 from the University of Birmingham, England, in Biochemistry and was a postdoctoral fellow of the National Research Council of Canada from 1959 to 1960. In addition to academic appointments, spent 1965-1968 as a Senior Scientist with Shell Research Ltd. in England. Senior Scientist for Microbiology and Biochemistry, Office of Naval Research, Europe, 1989-1990. Primary research interests are mechanisms of the interactions of cells with surfaces, and algal biotechnology.

Dr. James F. Garvey, Associate Professor of Chemistry. Received Ph.D. from California Institute of Technology in Molecular Beam Physical Chemistry (1985) and continued postdoctoral studies at UCLA during 1985-87. Since 1987, has been on the faculty of the University at Buffalo investigating complex molecular clusters in molecular beams and the deposition of thin films using molecular beam methods.

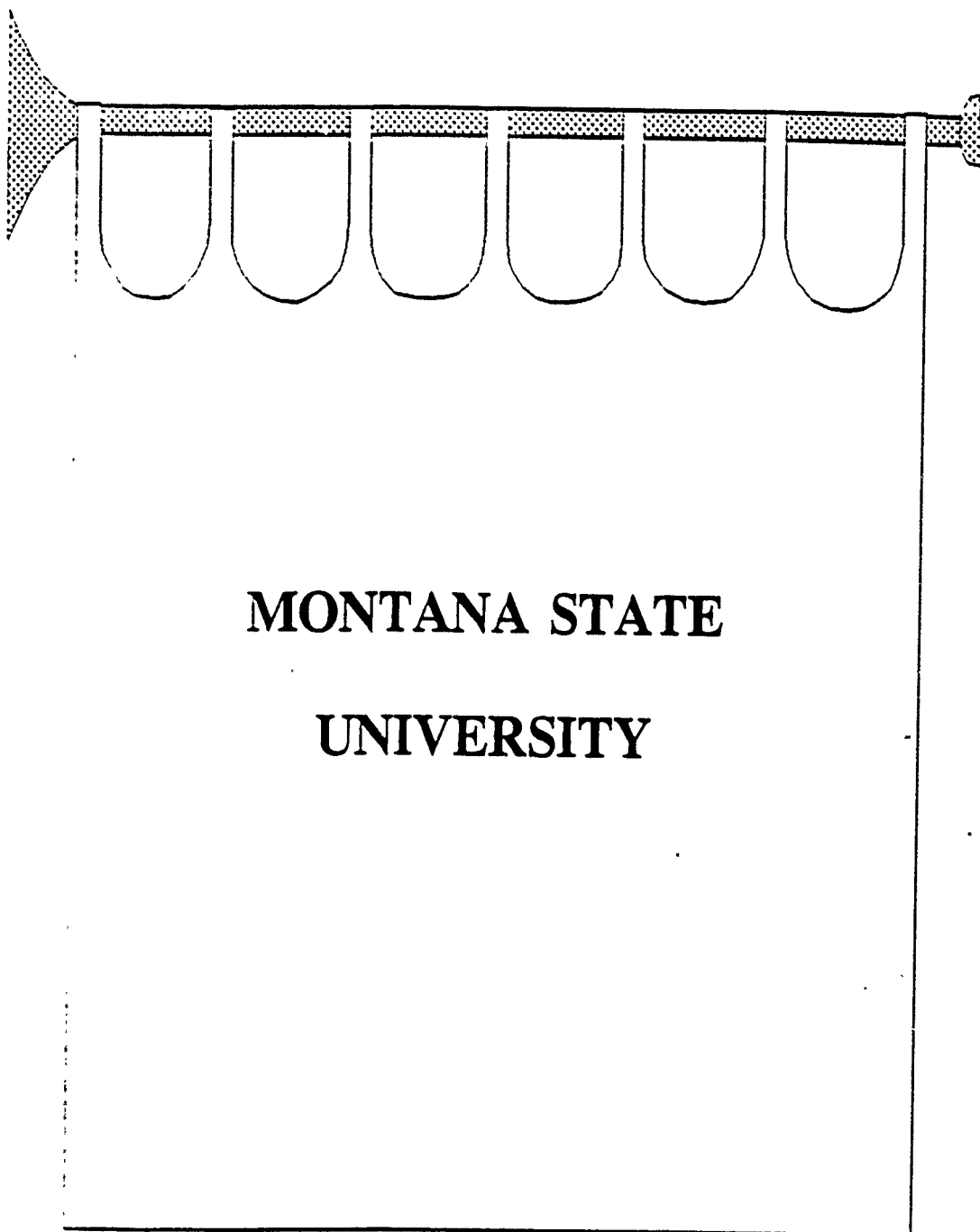
Dr. Rossman F. Giese, Jr., Professor of Geology. Studies static and dynamic structures of clays and other minerals; a key interest is adsorption and desorption of organic materials in contact with intercalating clays. Received Ph.D. in Mineralogy/Crystallography from Columbia University in 1962 and was Senior Physicist with the Carborundum Company from 1961 to 1966 before joining the faculty of the University at Buffalo.

Dr. Robert J. Good, Emeritus Professor of Chemical Engineering. Received Ph.D. in 1950 from University of Michigan and an M.S. from the University of California, Berkeley, both in Chemistry. Recipient of the Kendall Award for Surface and Colloid Chemistry. Theoretical studies of contact angle measurements include protein solubility, polymer solubility and phase separation, cell membrane fusion, hydrophobic bonding and hydrogen bonding adhesion.

Dr. Gordon A. McFeters, Professor of Microbiology, Montana State University. Received a Ph.D., 1967, in Microbiology from Oregon State University, following M.S. from Loma Linda University, 1963. Performed research at the Swiss Federal Institute for Water Resources and Water Pollution Control, 1987-1988. Research interests include water and wastewater microbiology, physiology of waterborne bacteria, microbial ecology, and biodegradation in soil and groundwater.

Dr. George H. Nancollas, Distinguished Professor of Chemistry. Received Ph.D. from the University of Wales and D.Sc. from the University of Glasgow (1963). Since 1965, has been on the faculty of the University at Buffalo investigating the kinetics of crystallization and dissolution, and the thermodynamics of mineral species in complex environments. Professor Nancollas has been recognized by the American Chemical Society with the 1977 Jacob Schoellkopf Medal and by the International Association for Dental Research with the 1984 Basic Research in Biological Mineralization Award.

Appendix B. (1) Continued Collaboration with Montana State University, (2) Potential TIE Projects with other Universities, (3) Development of a Young Scholars Program, (4) International Collaboration



White Paper - Continued Collaboration with Montana State University

Background - History of IUCB Relationship to Montana State Activities

The IUCB has maintained an active component of its research program at Montana State University (MSU). This has been funded entirely by NSF, in a subcontract to Professor Keith Cooksey and Professor Gordon McFeters, both of the Department of Microbiology. The collaboration grew out of existing scientific collaborations between Cooksey and Baier through ONR funding and collaborations between Gardella and Professor Jerry Lapeyre of the Physics Department. NSF had funded a planning grant at MSU joint between Cooksey and Professor William Characklis. This was combined with the initial IUCB planning grant from NSF. Cooksey has been on leave from MSU for two years at ONR-Europe in London. His IUCB sponsored research has continued unfunded, allowing startup for McFeters.

Characklis turned to pursue of an NSF Engineering Research Center ERC in the field of microbial processes at interfaces. This was awarded and funded at the \$7M/5 year level beginning FY 90. This activity has some (but not complete) overlap in focus with the IUCB. The main thrust of ERC's is engineering research and education. As such, a major activity is to develop an engineering education program. While there are subjects of joint interest, the IUCB focus is mainly on basic research, with applications to biomaterials and biofouling control. The MSU ERC is mainly concerned with problem solving, educational activities and developing new academic activities, in addition to the research.

Need for MAB Consideration

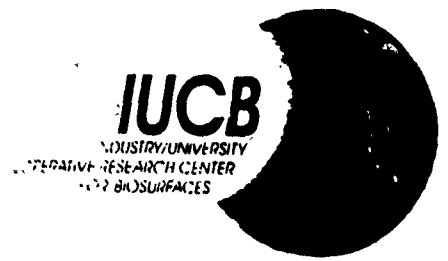
Given these issues, the IUCB Co-Directors scheduled meetings with interested faculty at MSU to discuss scientific expansion of the program in areas of interest with the IUCB. In addition, we need to discuss the possibility of a formal relationship with the ERC. Finally, to continue the relationship, the MSU faculty must help in the membership expansion of the IUCB to allow specific member identified interests with their activities.

The MAB should consider whether, given budget cutbacks, this activity should be continued as a formal portion of the IUCB. Further, an action plan by the MSU faculty should be developed to add membership and identify research interests and overlaps.

Action Taken by IUCB

Gardella visited MSU in February, 1991, completing meetings with McFeters and other potential faculty collaborators. At that time, the possibility of added membership and scientific collaboration was found to be reasonable and this will be reported to the MAB in June.

Baier held discussions with Characklis to outline areas of mutual scientific benefit. Further, discussions were held about the possibility of membership conversion. Possible conflicts in membership solicitation were discussed. Baier will have further discussions with Characklis about the nature of formal agreements between ERC and IUCB.



TO: Coordinating Committee

FROM: R.E. Baier

DATE: 31 December 1990

RE: Cooperation with the Engineering Research Center at Montana State University

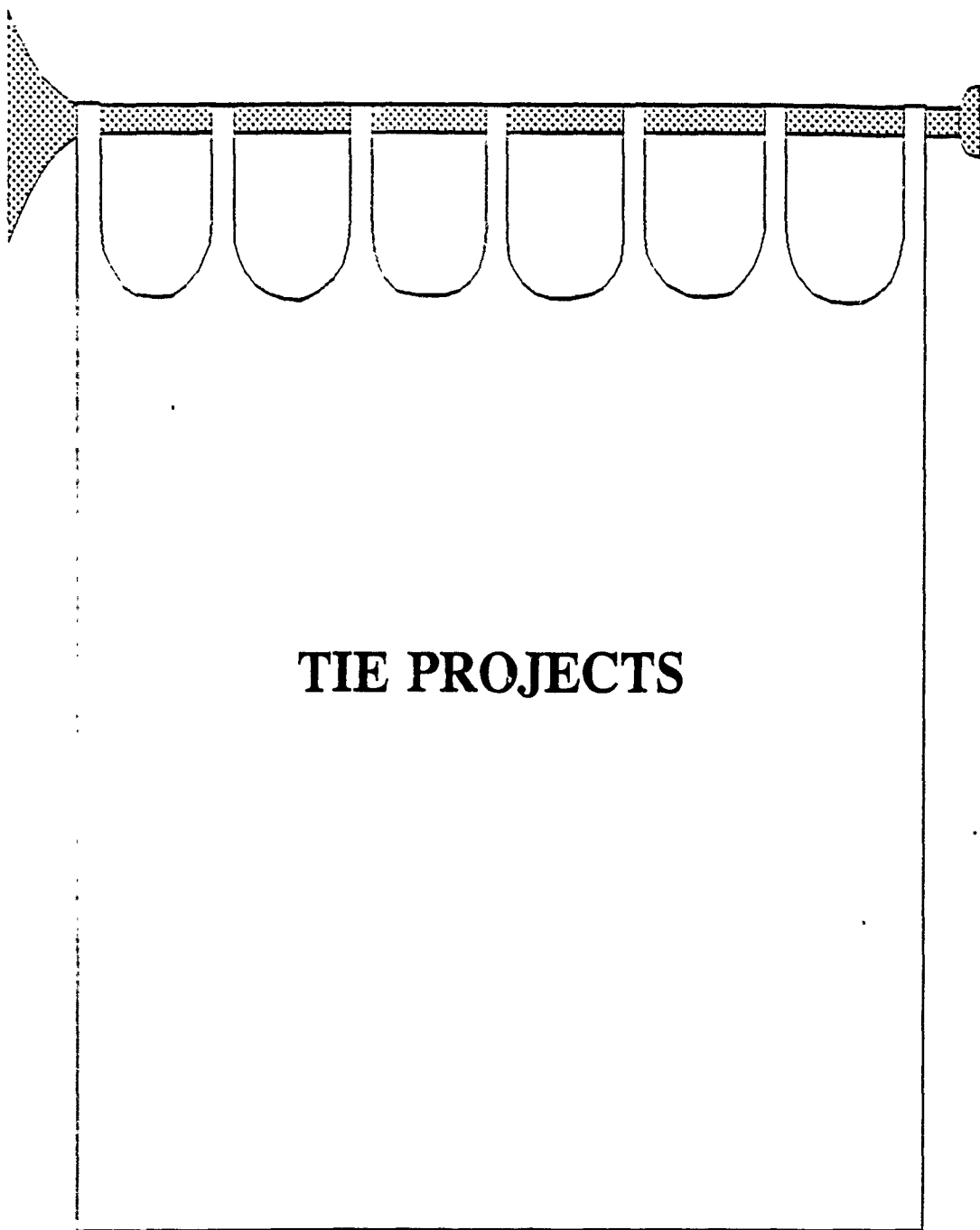
After many tries, telephone discussions were finally held this past week with Professor Bill Characklis regarding cooperative activities of the IUCB and Montana State's Engineering Research Center on Microbial Processing at Interfaces.

It was quickly agreed that, where scientific interests overlapped, there would be every reason to continue the informal and mostly friendly cooperation that has existed for more than a decade between and among our various faculty groups.

Getting down to business, it was the expressed opinion of Dr. Characklis that further formal relationships between Montana State and SUNY Buffalo are unlikely. It was noted that the existing relationship with the IUCB is viewed by Montana State officials with some degree of concern, and that dissolution of the current I/UCRC would be a comfortable outcome for them.

Dr. Characklis said that he would put Dr. Nick Zelver, their ERC's Director of Industrial Relations, in touch with us to consider whether any possibility exists for our joint pursuit of industry sponsors. It was agreed that overlapping industry memberships -- although unlikely--would be the most reasonable mechanism to assure formal continuing relationships between our two universities and/or centers.

I will report further information as it becomes available.



White Paper - Potential Tie Projects with Other IUCRC's

January 15, 1991

Background

The IUCRC program at NSF enhances funding of joint research projects between two IUCRC's. These are called "Tie" projects. Since there are only a few biological IUCRC's, and there is much overlap in the membership, the IUCB has investigated a number of potential Tie projects to enhance funding of the Center program. What is required by NSF is commitment for additional funding by two Members (one from each Center) at the level of \$25K/year each. NSF would match the \$50K total to give project support at the \$100K level per year. These projects must be wholly new projects accomplished jointly between the two centers. They should not be loosely associated separate projects.

Procter and Gamble is a member of the IUCB and the IUCRC at San Antonio University of Texas Health Sciences Center. There has been considerable scientific interest in collaborating with San Antonio on cell growth studies on well defined surfaces. Alfred University has an IUCRC (with potential State designation) in Glass Science. Much potential work could be done in surface science of these materials, especially with extension to ceramics, a special strength of the Alfred College of Ceramic Science. Gardella has been collaborating with faculty at Brown University who have a connection with the Rhode Island Center for Thin Film Science. This latter IUCRC has some projects in organic thin films by Langmuir Blodgett technology. Some potential for collaboration could exist here, although this is a tenuous connection.

Need for MAB Consideration

The MAB will need to set a priority on developing one strong tie with either Alfred, San Antonio or Brown. The MAB should consider the additional information which would be desired and the place this work would fit into the expanded research program. The MAB should consider potential for adding new members on the basis of this collaboration.

Action Taken by IUCB

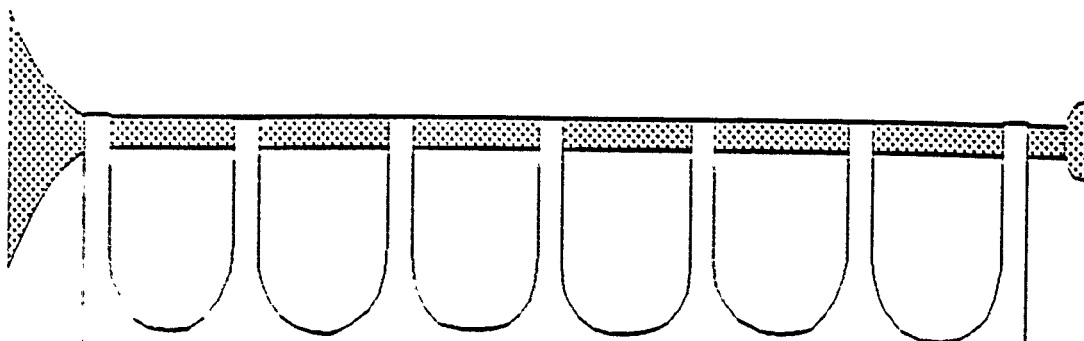
Brown researchers were invited for a visit and seminar, which was attended by GIBCO representatives, followed by discussions on site at GIBCO. The concept of a tie project was discussed with Gardella. This seemed a distant possibility to the Brown faculty, primarily because they saw little value for the Rhode Island IUCRC, which has no interest in their work. Primary area of interest would be overlaps in developing cell growth and adhesion studies with emphasis on neural biomaterials.

Discussions were held with Barbara Boyan in January 1990 by Gardella and January 1991 by Anne Meyer at the yearly IUC national meeting in Washington. Boyan is tentatively scheduled to meet with the MAB and discuss mutual scientific interests at the next MAB meeting.

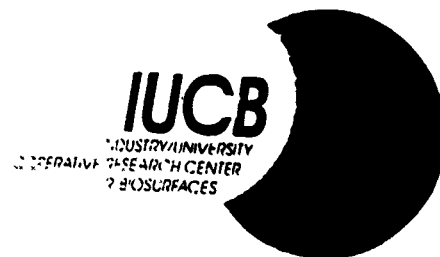
Preliminary discussions were held between Bob Baier and David Pye of Alfred in a telephone conversation with Alex Schwarzkopf. Further discussions were held with Anne Meyer in Washington. For both projects definition of technical areas of overlap has not been done. Further, investigations of interests with various members should be made by both Centers.

Action Required by MAB

Further investigation of the potential scientific overlaps could allow for a focus choice by June. More information is needed about Alfred collaborations. One program should be chosen. Potential member sponsorships should be developed. Once funding is in place, request for NSF support of Tie project should be discussed with Alex Schwarzkopf and included in the annual renewal proposal to NSF (in August).



YOUNG SCHOLARS PROGRAM



TO: Coordinating Committee

FROM: R.E. Baier

DATE: 31 Dec 90

SUBJ: NSF Young Scholars Program -- IUCB Plan Update

ENCL: 1. Extracts from Great Lakes JASON Curriculum
2. JASON PROJECT 1991: A GALAPAGOS ADVENTURE
3. Gulf Offshore Satellite Applications Project (GOSAP)
4. Project CLASS: Cameras Located Aboard Space Shuttles
5. QUICKLOOK Report : Navy Oceanographer Shuttle Observations

XC: Members Advisory Board

These will be the essential elements of my suggested proposal to NSF, requesting funding for an IUCB Young Scholars Program.

(1) The initial topical focus will be on "biosurfaces" of natural bodies of water, with emphasis on the air/water and underwater boundaries of Lakes Ontario and Erie.

(2) The scientific focus will be on mathematical and physical concepts which allow special information to be extracted from various remote sensing (satellites and aircraft, as well as fixed platform) and in situ (limnologic and oceanographic) measurements.

(3) The major recording medium will be photography, supplemented by various related media to especially include video formats. The most prominent corporate sponsor of this program should be Eastman Kodak Corporation of Rochester, NY.

(4) Student activities, under the general supervision of their own science teachers, will include four exciting and enriching field trips (two at Rochester facilities and two at Buffalo facilities), and a selected portion of the curriculum made available by the National Science Teachers Association for the Great Lakes Jason program (see Enclosure 1).

(5) The first field trip will be hosted by NSF's Industry/University Cooperative Research Center for Biosurfaces(IUCB), at the original campus of the State University

at New York at Buffalo, where the students will meet some of our scientists and be introduced to "biosurface" problems through lecture, demonstrations and laboratory tours.

The second field trip will be to the Information Center and Research Laboratories of Eastman Kodak Corporation, meeting some industrial scientists and receiving high-visual-content demonstrations of important scientific principles of imaging.

The third field trip will take the student groups back to SUNY Buffalo's larger, Amherst campus to view and learn about the powerful technology called a Geographic Information System, a decision support system that works with geographically (spatially) referenced data. Like the IUCB, our National Center for Geographic Information and Analysis is sponsored by the National Science Foundation and also supported as one of the University at Buffalo's Organized Research Units.

The final field trip, toward which the entire program builds in intensity, is to the Rochester Museum and Science Center, where the students will (depending upon timing and funding) participate directly in live satellite downlink-broadcasts of realtime activities of JASON in the Galapagos Islands (see Enclosure 2). Alternatively, they will participate through video re-creations in the 1990 JASON explorations of the shipwrecks in Lake Ontario, together with video records of many of the related activities such as observations of zebra mussel infestations in the Welland Canal.

At program end, they will receive a handsome Certificate of Completion (see last page of Enclosure 1) and a question and answer guidance period with regard to further opportunities for education and careers in engineering and science.

(6) It is our hope, in the second year of this Young Scholars program, to expand participation to include the Offshore Satellite Applications Project. Now focussed on the Gulf of Mexico (GOSAP, see Enclosure 3), that Project might also be expanded to provide greater regional attention to the Great Lakes. Our expectation is that, in addition to Kodak, other large industry sponsors such as AMOCO will enable this program expansion to the topic of "offshore exploration".

(7) Daring to dream, our vision extends to the third year and well beyond as leading participants in Project CLASS, Cameras Located Aboard Space Shuttles (Enclosure 4), especially following up the exciting hand-held camera observations of a Navy crew member aboard the space shuttle CHALLENGER (see Enclosure 5).

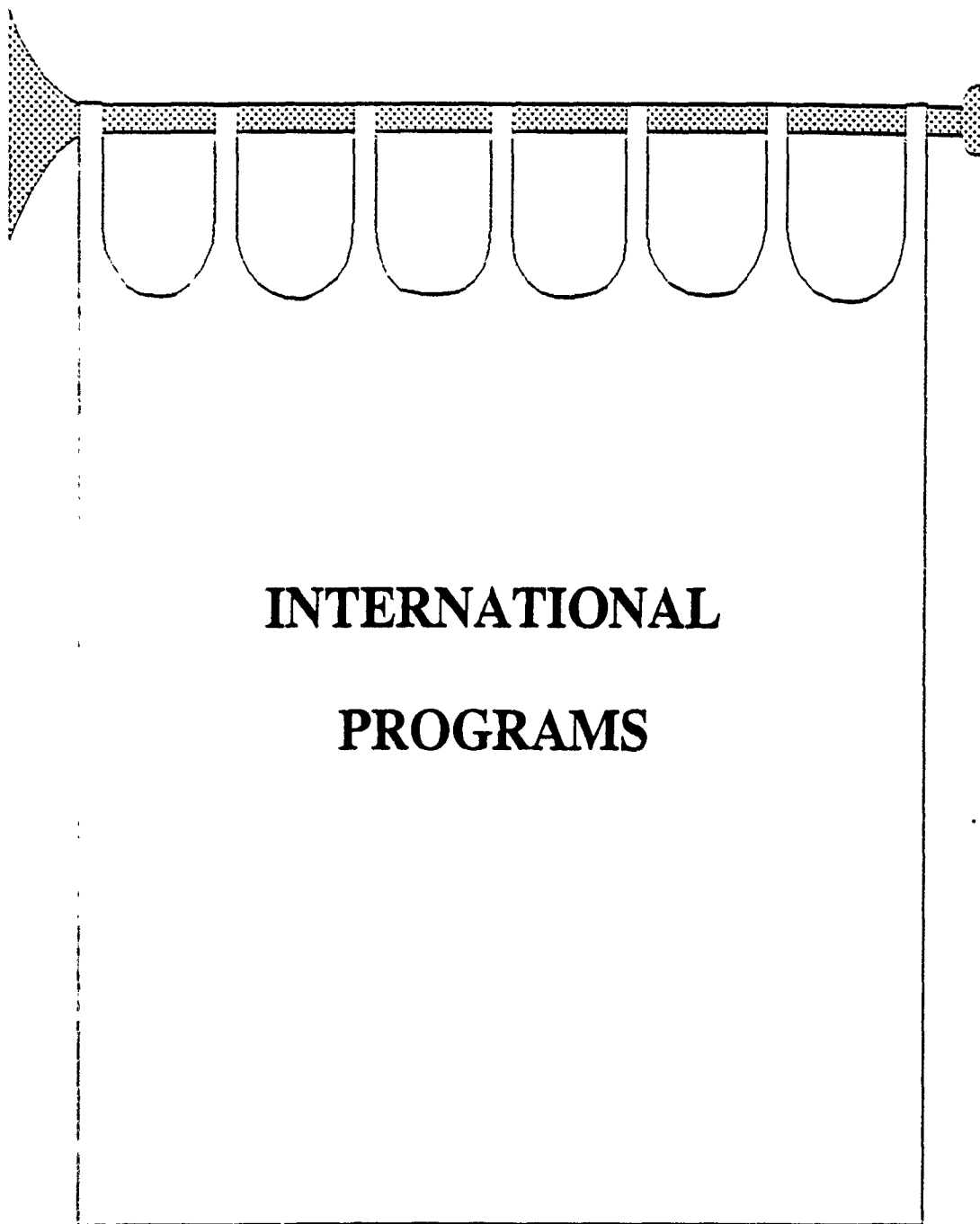
(8) Whether we proceed beyond Year 1 depends, of course, on gaining the endorsement and the financial support of both industry and government sponsors. Specifically, we seek financial support in the amount of \$40,000 per year for at least two years, half to come from industry sponsors and half to come

from the Young Scholars Program of the National Science Foundation. This will allow us to reach approximately 160 students each year, paying for the necessary bus transportation, away-from-school meals, modest supplies, and required compensation to the JASON program through the Rochester Museum and Science Center. Project management costs through the IUCB will be at the barest minimum, and it is proposed that outside funding from both industry and government will be forgiven all but the New York State-mandated minimum overhead charge in accord with the IUCB's and NSF's agreement with the Research Foundation of SUNY.

(9) The most expeditious way to apply the industry funds made available to this program would be to have Eastman Kodak Corporation become a Member of the IUCB, at the standard \$40,000 annual fee that entitles Kodak to all rights and privileges of membership. This Young Scholars program proposal would be considered one of the group to be reviewed and funded by the Members Advisory Board, and its funding all but assured by the strong condition that Kodak desires this outcome.

(10) In subsequent years, as industrial sponsors like AMOCO might choose greater emphasis on offshore exploration, or desire additional numbers of students to be accommodated (perhaps in "hometown" areas of some of our industry sponsors outside New York State), the incremental costs will probably also be of the order of \$40,000 per year.

Jeff Biv



THE UNIVERSITY OF NEW SOUTH WALES

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TELEX AA26054 • TELEGRAPH: UNITECH, SYDNEY • TELEPHONE 697 2222

EXTN.

PLEASE QUOTE



Centre for Biomedical Engineering

29 May 1991

Professor R.E. Baier
Research Professor of Biophysical Sciences,
110 Parker Hall,
University of Buffalo,
BUFFALO, NY 14214,
U.S.A.

Dear Professor Baier,

Thank you for the opportunity to meet with you to discuss the development of a cooperative program between our Centres. It was evident that our Centres have complementary skills which will provide a basis for productive interaction.

It is my understanding that the cooperative program will have the overall aim of providing a mechanism whereby both United States' and Australian medical device industries will have access to our facilities for the purposes of generating, developing and/or evaluating medical devices and potential biomaterials. A specific goal of the cooperative program would be to provide device data for consideration by the regulatory authorities of both countries. Our Centres are well placed in the biomaterials/medical device areas to achieve these aims.

I am in full agreement that the cooperative program requires a number of elements to be associated with it. The program should:

1. Service industry's need to obtain rigorous data for regulatory authorities.
2. Provide a mechanism to assist small entrepreneurial companies for product development.
3. Establish an applied research base in biomaterials using the complementary skills of the Centres.

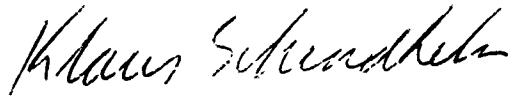
Such a program requires careful planning which should begin as soon as possible. From our discussions a consensus has emerged that the planning process should involve not only the development of a suitable program structure but also an initial seed project. The seed project should have clear identifiable developmental goals with support from both the United States' and Australian industry. The seed project would provide an opportunity to explore the inter-centre dynamics and assist in the finalisation of the structure.

I believe that a unique opportunity exists to set up a program in the biomaterial/medical device area which transcends our national boundaries and will be

of direct benefit to medical device development in both the United States and Australia.

I am excited by the potential of our future interactions.

Yours sincerely

A handwritten signature in cursive script, appearing to read "Klaus Schindhelm".

Klaus Schindhelm BE, PhD
Director.

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EXTN. 5164

PLEASE QUOTE

Centre for Biomedical Engineering

6th June, 1991

Professor R. Baier,
Centre for Biosurfaces,
110 Parker Hall,
University of Buffalo,
BUFFALO NY 14214,
U.S.A.

Fax: 0015-1-716-835-4872

Dear Bob,

I have been in contact with DITAC and it would seem that my pathway is not as clear as yours is with the NSF. Funding through DITAC appears to be through formal application into a pool of money for international collaboration. It does not appear that any funds have been put aside specifically for the type of arrangements which you have described. I believe that I can overcome this problem using your application to the NSF as a lever. Therefore could you send or fax to me a copy of your application as soon as possible so that I can begin to turn some bureaucratic wheels.

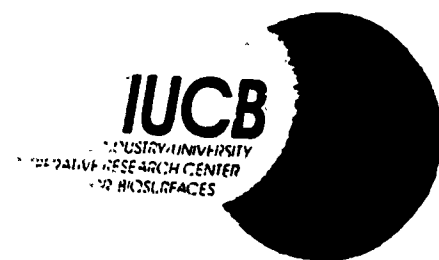
I have been in contact with Tim Nash of Australian Cyanamid. In two weeks' time I will be discussing potential projects that could fall within the scope of our proposal. I will give you a full run-down of that meeting once it has taken place.

Best regards,

Yours sincerely,

A handwritten signature in cursive script, appearing to read 'Klaus'.

Klaus Schindhelm



MEMORANDUM

TO: Center Sponsors, Faculty, and Associates

FROM: R.E. Baier, Co-Director

DATE: January 4, 1991

RE: Internationalization of the Center

REF: (a) Telefax. Dr. Bruce Milthorpe to R. Baier. 12 Oct 1990
(b) Telefax. Brian Corrigan to R. Baier. 29 Oct 1990
(c) Telefax. R. Baier to Professor Milthorpe, 30 Oct 1990
(d) Telefax. Dr. Milthorpe to R. Baier. 9 Nov 1990

ENCL: Copies of refs (a), (b), (c), and (d)

BACKGROUND:

I was an invited participant at the Australia- United States Science and Technology Workshop, Canberra, Australia, 12-15 August 1990, sponsored by the National Science Foundation (USA) and the Department of Industry, Technology, and Commerce (DITAC, Australia). This workshop identified areas for collaborative research that new funding from both national governments might support, under a re-negotiated Science and Technology Agreement, beginning in 1991. Professor Bruce Milthorpe of the Centre for Biomedical Engineering, The University of New South Wales, Kensington (Sydney) Australia, contacted me by phone early in October 1990 at the recommendation of Australian officials. References (a), (b), (c), and (d) provide some details of our further communication.

OPPORTUNITY:

My recent discussions with the manager, Dr. Carole Ganz-Brown, of NSF's Australia/New Zealand program office indicate that an initiative program to internationalize the NSF Industry/University Cooperative Research Centers (IUCRC) might provide us with a modest planning grant in early 1991. We expect to suggest to Dr. Ganz-Brown that it would cost approximately \$35,000 over the next year for us to engage in a careful planning process, with our Australian colleagues, to design a pilot cooperative program.

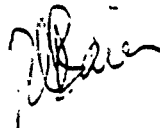
The planning process will explore (1) the levels, numbers, and frequencies of desired personnel exchanges or visits between our centers; (2) the optimum selection of research projects, within the already agreed upon scope of biomaterials testing and vascular graft evaluation, and possible expansions of that scope; and (3) how to manage the interactions of specific industries or industry groups associated with each of our centers, with regard to issues of intellectual property, confidentiality, and mutually beneficial economic growth in both nations.

Dr. Milthorpe may initiate a parallel planning process from his Centre in Australia, requesting equivalent funding from DITAC.

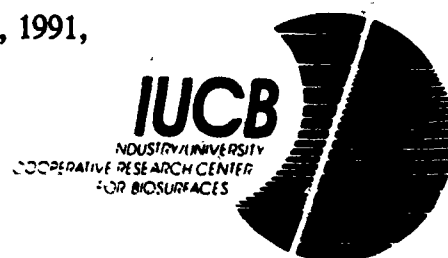
ACTION:

With the concurrence of our Members Advisory Board, the IUCB is prepared to embark upon the necessary planning process if requested to do so by NSF. Specific elements of our planning schedule, and suggested principal participants, are now under consideration for inclusion in a letter to Dr. Ganz-Brown.

If funds are to be received from NSF's current "initiative" budget, it is important that our suggested planning process be in the hands of Dr. Ganz-Brown as soon as possible.



MEMBERS ADVISORY BOARD MEETING



June 26 and 27, 1991
Members, NSF, and Invited Faculty
567 Capen Hall (Jeannette Martin Room)
North Campus

June 28, 1991
Open Session
567 Capen Hall (Jeannette Martin Room)
North Campus

Wednesday - June 26, 1991

Chairman: Robert Baier (Co-Director)
Facilitator: Karen Howard-Nordan (Procter & Gamble)

8:00 am	INTRODUCTION OF GUESTS - <i>R. Baier</i> INTRODUCTION OF NEW MAB MEMBER (Dr. Erwin Vogler, Becton-Dickinson)
8:15 am	HISTORICAL OVERVIEW - <i>R. Baier</i>
9:00 am	OPERATION SUMMARY (Critical Path) - <i>A. Meyer</i> <ul style="list-style-type: none">- Fundamental Questions- Experimental Approaches- Status
10:30 am	COFFEE BREAK
10:45 am	OPERATION SUMMARY, continued - <i>A. Meyer</i> <ul style="list-style-type: none">- Clarifications (Question/Answer Period)- Specific Examples
12:00 noon	LUNCH BREAK
1:00 pm	OPERATION SUMMARY, continued - <i>A. Meyer</i> <ul style="list-style-type: none">- Specific Examples, continued- Clarifications (Question/Answer Period)
2:30 pm	BREAK
2:45 pm	PROGRAMMATIC OVERVIEW - <i>J. Gardella, Jr., R. Baier</i> <ul style="list-style-type: none">- Generalizations- Where Do We Go From Here? (Part I - General)
5:00 pm	ADJOURN UNTIL DINNER SESSION

Wednesday - June 26, 1991, continued

6:30 pm

WORKING DINNER - *Holiday Inn-Amherst*
[MAB, NSF and Guest, Program Office only]

BUSINESS ISSUES - *J. Gardella, Jr., R. Baier*

- Montana State University: determine appropriate next steps and timing
- Personalization of Interactions (Technical Monitors and annual visits)
- Management Issue (Program Manager/Executive Director)
- Receipt of Proposed Bylaws

9:00 pm

ADJOURN UNTIL MORNING SESSION

Thursday - June 27, 1991

Chairman: Karen Howard-Nordan (Procter & Gamble)

Facilitator: Margaret Coyle-Rees (Procter & Gamble)

8:30 am

WHERE DO WE GO FROM HERE? - *K. Howard-Nordan*
- Part II - Specifics

Open Discussion, with Participating Faculty

In addition to specific technical questions and answers, the following needs should be addressed by the end of the discussion:

for the Core Program: feedback from the MAB on where to put focus and balance of time

for the Project Directors: midcourse corrections based on feedback from the MAB

for the Program Office: suggestion of subject areas in which to solicit proposals, and guidance in bringing certain topics to closure

for the Members: resolution of "Where do we go from here?", and "How is this useful to me?"

10:30 am

COFFEE BREAK

10:45 am

OPEN DISCUSSION, continued - *K. Howard-Nordan*

12:00 noon

LUNCH BREAK

1:00 pm

OPEN DISCUSSION, continued - *K. Howard-Nordan*

Thursday - June 27, 1991 continued

2:30 pm BREAK

2:45 pm MAB - CLOSED SESSION
[Members, NSF Representative, and Evaluator only]

4:00 pm MAB RECOMMENDATIONS AND ACTION ITEMS - *K. Howard-Nordan*

7:00 pm RECEPTION WITH POTENTIAL NEW MEMBERS - *Holiday Inn-Amherst*

Friday - June 28, 1991

Chairman: Robert Baier (IUCB, Co-Director)
Facilitator: Joseph Gardella, Jr. (IUCB, Co-Director)

8:30 am INTRODUCTIONS - *R. Baier*

8:45 am THE I/UCRC PROGRAM FROM DIFFERENT PERSPECTIVES
 -National Science Foundation,
 Alex Schwarzkopf, Project Director
 -University at Buffalo/Participating Faculty,
 Frank Bright, Investigator
 -Industry Members
 Karen Howard-Nordan, Procter & Gamble Co.
 -Center Evaluator
 Edward Zablocki, University at Buffalo,
 Coordinator, Industrial Relations and Economic
 Development
 -Question and Answer Period

10:00 am INTERPRETATION OF THE IUCB's GOALS - *R. Baier*

10:30 am COFFEE BREAK

10:45 am "GATEKEEPING" TECHNOLOGY TRANSFER
 David Tansik
 Evaluator, I/UCRC at University of Arizona
 -Question and Answer Period

11:45 am RECENT TECHNICAL ADVANCES (nonproprietary) - *J. Gardella, Jr.*
 -Question and Answer Period

12:30 pm FORMAL SESSION ADJOURNS FOR LUNCH AND
 FURTHER DISCUSSIONS/FACILITY TOURS

Afternoon ONE-ON-ONE DISCUSSIONS AND TOURS OF LABORATORY
 FACILITIES, TO BE ARRANGED ON AN INDIVIDUAL BASIS

MEMBERS ADVISORY BOARD MEETING

January 29 - 30, 1991

Agenda

January 29, 1991 - Tuesday

8:30 - 9:00 am	Continental Breakfast
9:00 - 10:30	Opening Remarks and Overview of Meeting
10:30 - 10:45	Coffee Break
10:45 - 12:15 pm	Technical Review and Selection of Proposals
12:15 - 1:15	Working Lunch and Beginning of Open Session
1:15 - 3:15	Technical Review and Selection of Proposals (cont.)
3:15 - 3:30	Break
3:30 - 5:00	Technical Review and Selection of Proposals (cont.)
5:00	Members Return to Holiday Inn - Amherst
6:30 - 7:30	Reception in the Niagara Room, Holiday Inn - Amherst
7:30	Dinner

January 30, 1991 - Wednesday

8:15 - 8:30 am Continental Breakfast

8:30 - 10:00 Final Ranking of Proposals

10:00 - 10:15 Coffee Break

10:15 - 11:00 Final Ranking of Proposals (cont.)

11:00 - 12:30 pm Reports from Co-Directors

- Montana State University
- New Member Development

12:30 - 1:30 Lunch

1:30 - 3:00 Reports from Co-Directors (cont.)

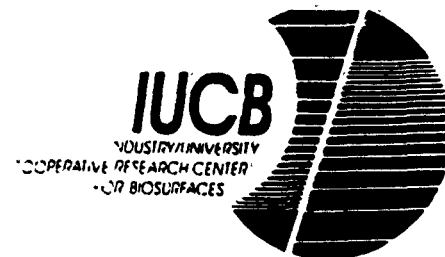
- TIE Projects
- Young Scholars Program
- International Program

3:00 - 4:00 Members Advisory Board and Evaluator Closed Session

4:00 - 5:00 Seminar - Dr. Barbara Boyan, University of Texas

CENTER FOR BIOSURFACES

Members Advisory Board Meeting



Closed Session

Tuesday - June 26, 1990

(Parker Hall, South Campus)

- | | |
|---------------|---|
| 8:00 | Continental Breakfast |
| 8:30 - 9:30 | Review of Core Program, <i>R. Baier</i> |
| 9:30 - 9:45 | Break |
| 9:45 - 12:00 | Review of IUCB Sponsored Projects, <i>A. Meyer and J. Gardella</i> |
| 12:00 - 12:45 | Lunch |
| 12:45 - 2:45 | Review of IUCB Sponsored Projects (Continued), <i>K. Cooksey and F. Bright</i> |
| 2:45 - 3:00 | Break |
| 3:00 - 4:30 | Review of New Sponsored Projects, <i>L. Carter, J. Campbell, E. Ruckenstein and R. Good</i> |
| 4:30 - 5:30 | Review of Proposed Projects, <i>G. Nancollas and G. McFeters</i> |
| 5:30 | Adjourn |
| 7:00 | Dinner |

Wednesday - June 27, 1990

(Parker Hall, South Campus)

- | | |
|---------------|--|
| 8:00 | Continental Breakfast |
| 8:30 - 9:15 | Summary of Status of Data/Action Items, <i>R. Baier</i> |
| 9:15 - 10:15 | Members Advisory Board Session with NSF Program Manager and Evaluator, <i>A. Schwarzkopf and E. Zablocki</i> |
| 10:15 - 10:30 | Break |
| 10:30 - 11:45 | MAB Recommendations and Action Items for Program Office |
| 11:45 | Adjourn Closed Session |

Open Session

Wednesday - June 27, 1990

(Marriott Inn, near North Campus)

- | | |
|--------------|--|
| 11:45 - 1:00 | Lunch with Prospective MAB (Members Advisory Board) Candidates |
| 1:00 - 1:30 | Introduction and Overview of IUCB, <i>D. Goupil - Chairman, Members Advisory Board and A. Schwarzkopf - Program Manager, National Science Foundation</i> |
| 1:30 - 2:00 | Opportunities for MAB Candidates, <i>R. Baier - Co-Director, IUCB; J. Gardella - Co-Director, IUCB; and E. Zablocki - National Science Foundation Evaluator</i> |
| 2:00 - 2:15 | Break |
| 2:15 - 4:00 | Summary of Technical Progress to Date (nonconfidential information only), <i>R. Baier - Co-Director, IUCB; J. Gardella - Co-Director, IUCB; and A. Meyer - Program Manager, IUCB</i> |
| 4:00 - 4:30 | Questions and Answers |
| 4:30 | Adjourn Open Session |
| 6:30 - 9:30 | Early Registration and Reception for ONR/IUCB-Sponsored Workshop on "Nonpolluting Control of Biosurface Fouling" (Separate Agenda enclosed) |

FACULTY & STUDENTS

STUDENT	EXPECTED DATE OF AWARD	DEGREE	RESEARCH AREA
Dr. Robert E. Baier			
Martin Casstevens	1992	Ph.D.	Thin-Film Biosensors
William Cherry	1991	M.S.	Sterilization Effects on Orthodontic Cutting Pliers
Laura Edsberg	1993	Ph.D.	Wound Healing as a Function of Biomechanical Factors
Vichet Chindavanig	1991	M.S.	Surface Properties Influencing Bioadhesion to Denture Reline Materials
James Hanlon	1991	M.S.	Initial Mineralization of Biomaterials
Michael Hayes	1991	M.S.	Tissue-Polymer Composites
James Malone	1992	M.S.	Surface Treatment of Hydroxyapatite Implants
Patrick McCabe	1992	M.S.	Composite Restorative Materials
Marion Olivieri	1992	Ph.D.	Protein Structure at Interfaces
Gary Palmer	1992	Ph.D.	Radiation Interactions with Polymers
Essam Kamal Taha	1991	M.S.	Biomaterials Interactions with Tooth Structures
Eduardo Vargas	1991	M.S.	Corrosion Susceptibility of Titanium and Titanium 6-Aluminum 4- Vanadium Alloy

STUDENT	EXPECTED DATE OF AWARD	DEGREE	RESEARCH AREA
Dr. Frank V. Bright			
Robert Bashnagel	1991	B.S.	Organized Media
Thomas Betts	1992	Ph.D.	Solvation Dynamics in Supercritical Fluids
Gino Catena	1991	Ph.D.	Cyclodextrin Studies and Fiber-Optic Based Sensors
Richard Dunbar	1995	Ph.D.	Fiber-Optic Chemical Sensing
Jingfan Huang	1991	Ph.D.	Dynamics of Inclusion Complex Formation
Pamela Kluczynski	1991	B.S.	Time-Resolved Fluorescence of Interfaces
Kevin Litwiler	1991	Ph.D.	Fiber-Optic Sensors and Studies of Surface Immobilized Reagents
Zhao Qian	1991	B.S.	Reversed Micelles
JoAnn Zagrobelny	1992	Ph.D.	Supercritical Fluid Solvation Kinetics
Jing Zhang	1992	Ph.D.	Dynamics in Organized Media

STUDENT	EXPECTED DATE OF AWARD	DEGREE	RESEARCH AREA
Dr. Joseph A. Gardella, Jr.			
Cindy Burkhardt	1991	Ph.D.	Kinetic Study of the Surface Hydrolysis of Polylactide; Surface Science of Polymer Blends
Xin Chen	1993	Ph.D.	Surface Science of Block Copolymers
Raghuram Dasari	1992	B.S.	Plasma Modification of Polymer
Norma DeGatica	1993	Ph.D.	Surface Science of Biopolymers on Glow-Discharge Titanium
Dan Hook	1991	B.S.	Radio Frequency Glow-Discharge Modifications of Surfaces
Robert Johnson	1993	Ph.D.	Quantitative SIMS of Langmuir Blodgett Film/Metal Interfaces
Helen Lee	1991	Ph.D.	Surface Science of Random and Block Functional Copolymers
Jianxin Li	1993	Ph.D.	Quantitative SIMS Langmuir Blodgett Films of Fatty Amine and Fatty Acids Monolayers
Clara Lo	1995	Ph.D.	Surface Science of Titanium
Patrick Schamberger	1993	Ph.D.	Surface Science of Modified Polystyrene and Biopolymers on Polystyrene
Rick Spring	1992	B.S.	Surface Hydrolysis of Poly Caprolactone
Cara Weitzsacker	1991	Ph.D.	SIMS Analysis of Solid State Polymerization; Surface Analysis of Coal

STUDENT	EXPECTED DATE OF AWARD	DEGREE	RESEARCH AREA
Dr. George H. Nancollas			
Eileen Burke	1994	Ph.D.	Calcium Phosphates
Vincent Cannavo	1991	M.S.	Gypsum Crystal Growth
Aileen Chin	1992	Ph.D.	Calcium Phosphates
Bruce Elder	1992	Ph.D.	Crystal Growth
Tristan Fuierer	1994	Ph.D.	Calcium Phosphates
Linda Kelash	1992	Ph.D.	Gypsum Hydrate Physical Growth
Eleftherios Paschalis	1991	M.S.	Biomineralization
Jian Tan	1994	Ph.D.	Biomineralization
Brian Tucker	1993	Ph.D.	Physical Chemistry Crystal Growth

Appendix E. 1991 Prospectus

STATE UNIVERSITY OF NEW YORK AT BUFFALO
MONTANA STATE UNIVERSITY AT BOZEMAN

IUCB

INDUSTRY/UNIVERSITY
COOPERATIVE RESEARCH CENTER
FOR BIOSURFACES

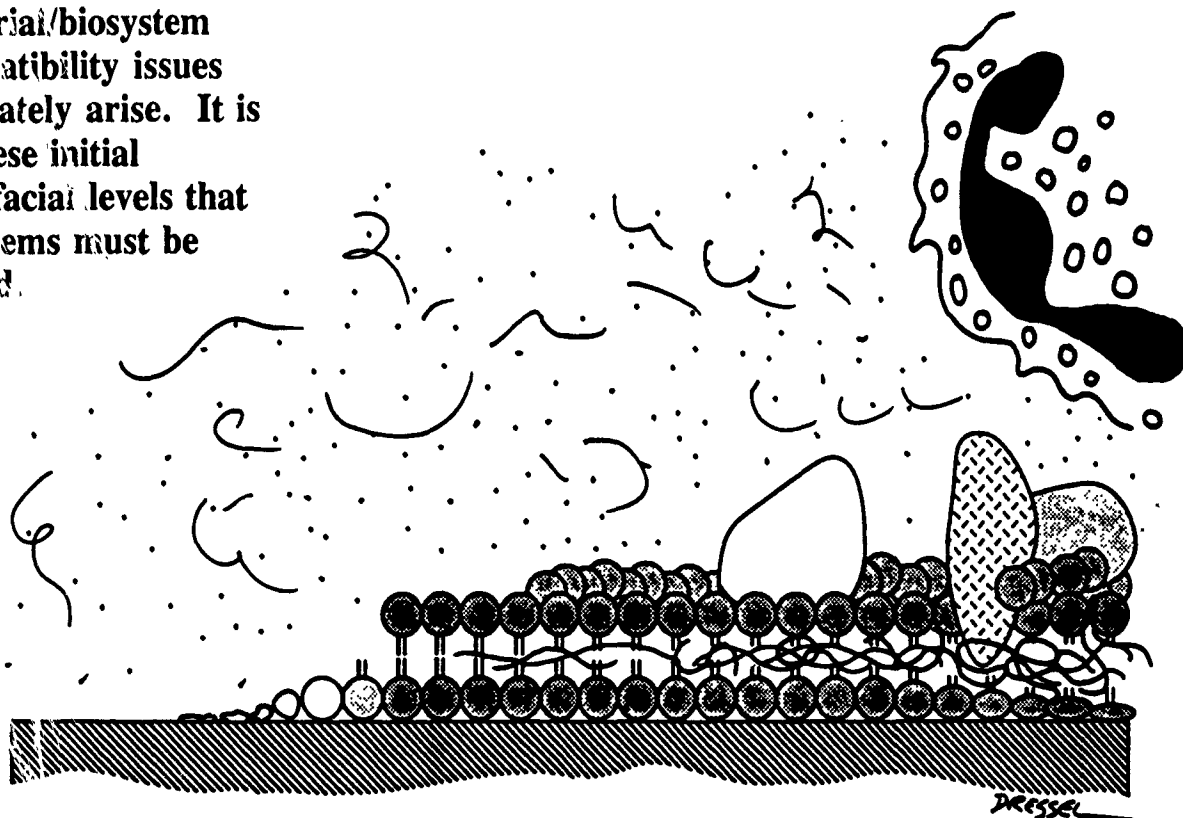
PRO

MISSION STATEMENT

The NSF Industry/University Cooperative Research Center for Biosurfaces is dedicated to fundamental investigations of the interactions among four principal phases -- substrata, macromolecular "conditioning" films, living cells, and surrounding media -- from which all material/biosystem compatibility issues ultimately arise. It is at these initial interfacial levels that problems must be solved.

This Prospectus describes the National Science Foundation (NSF) Industry/University Cooperative Research Center for Biosurfaces (IUCB). The Center's scientific focus and operating procedures were first developed by industry, government agency sponsors, University administrators, and faculty in August 1987. The Center then established a vigorous multi-University-based program addressing major research needs in biological surface science. The first meeting of the Members Advisory Board (MAB) was in March 1989.

This prospectus summarizes the program, as constructed with advice from the MAB, and indicates the benefits of membership for new sponsors. Center sponsorship is specifically eligible for favorable tax treatment in accord with the 1986 Tax Reform Act to encourage companies to increase their spending on basic research at universities.



FOCUS ON BIOADHESION - ITS PROMOTION AND PREVENTION

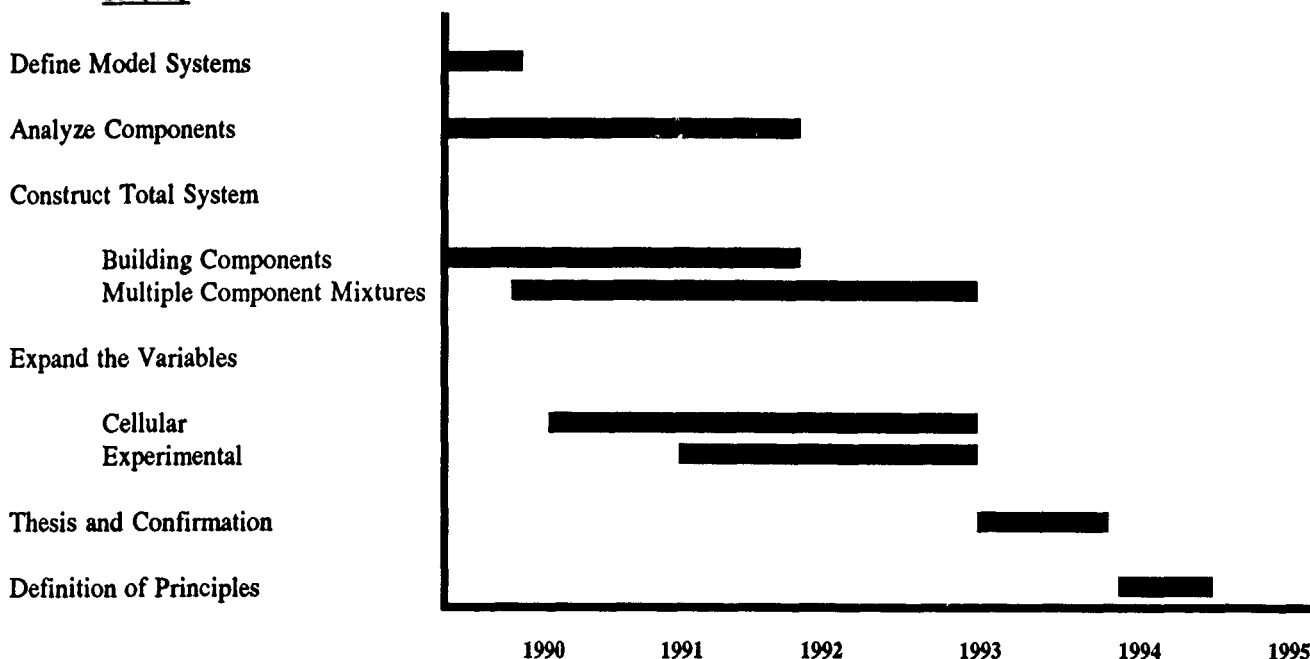
The focus of the Center for Biosurfaces' research program is on understanding, prediction, and control of biological adhesion.

Multidisciplinary studies of the mechanistic details (including physico-chemistry, biochemistry, and biophysics) of "conditioning" film formation, biopolymer deposition, and cell and protein adhesion to synthetic materials and model tissues are in progress. A Core Program is managed by the Center's two co-directors, together with Projects selected, structured, and prioritized by the Members Advisory Board. The Center for Biosurfaces' research program will shift and evolve as the ongoing projects answer current questions, uncover new questions, and as the membership and interests of the Advisory Board change. Additional industry and government agency membership on this Board is now solicited.

GOALS OF THE CURRENT RESEARCH PROGRAM

"THE FIVE YEAR MISSION"

TASKS



MEMBERS ADVISORY BOARD

The Advisory Board is made up of Member organizations, each with one vote. The Board meets semi-annually, to review ongoing projects and to set research priorities.

The membership fee, in accord with a formal Research Agreement negotiated between the University at Buffalo and member industries/agencies, is currently \$40,000/year. This fee entitles members to specific intellectual property rights, copyrights, and publication delays as noted in the research agreement. The Board Members also appoint technical monitors for their approved Projects and recommend TIE projects with other NSF-sponsored Industry/University Centers having complementary technologies.

PROGRAM-PROJECT ORGANIZATION

The Core Program provides central resources and a common technical base for the entire Center. It has both service and scientific elements. Service aspects include data collection and distribution for all Center members, as well as acquisition, fabrication into useful specimens, and characterization (in advance) of selected substrata that are used in all Center Projects. These specimens are provided to faculty teams and to Advisory Board Members as needed for particular experiments.

The major scientific aspect of the Core Program applies the modern array of surface physical/chemical analytical tools available to the Center for the qualitative and quantitative description of complex, primary organic layers acquired by the substrata.

At various stages in the exposures of substrata to relevant biological systems by Project teams, the Core Program also provides surface characterizations of the biosystem-modified specimens and the "conditioning" films or overlayers they retain.

Center Projects, proposed periodically by cooperating faculty teams, are reviewed and selected by the Advisory Board. The co-directors solicit these proposals from faculty on the basis of recommendations and suggestions from the Board.

Through the Program-Project structure, each funded Project benefits from the scientific developments of all other active Projects and from the "quality control" and surface analytical expertise of the Core Program. The separate Project efforts, therefore, are effectively integrated into a Center-wide assault on the important technical fronts defined by the Members Advisory Board.

A secondary ion mass spectrometer, a scanning Auger microprobe, and two electron spectrometers for chemical analysis are among many other instruments applied in Center projects. *These new, operating equipment items and their accessories provide more than \$3 million of immediate value to Center participants.*

For descriptions of projects funded by the Center, please see the insert page.

Brief biographies of the associated faculty also are included on the insert.

BRIEF BIOGRAPHIES OF ASSOCIATED FACULTY

Dr. Robert E. Baier, Research Professor of Biophysical Sciences and Co-Director, IUCB. Received Ph.D. in 1966 from the State University of New York at Buffalo in Biophysics and is a licensed Professional Engineer in the states of New York and Ohio. Was awarded a National Academy of Sciences-National Research Council postdoctoral fellowship in 1966 and performed postdoctoral research in surface science at the Naval Research Laboratory until 1968. From 1968 through 1984, was a Staff Scientist of the Advanced Technology Center of Arvin/Calspan (formerly the Cornell Aeronautical Laboratory of Cornell University). From 1985 to July 1989, was Director of the New York State Center for Advanced Technology in Health-care Instruments and Devices, leaving that post to devote more time to the IUCB.

Dr. Frank V. Bright, Assistant Professor of Chemistry. Received Ph.D. from Oklahoma State University in Analytical Chemistry (1985) and continued with postdoctoral studies in Analytical Laser Spectroscopy at Indiana University until 1987. Since 1987 he has been on the faculty of SUNY-Buffalo. Research efforts center on 1) instrumentation for chemical analysis; 2) quantifying the interfacial processes occurring at the distal end of fiber-optic sensors and probes; 3) steady-state and dynamic (time-resolved) fluorescence applied to bioanalytical problems; 4) elucidation of the fundamental processes that govern complexation phenomena in organized media; and 5) improving our understanding of solvation in supercritical fluids.

Dr. John H. Campbell, Assistant Professor of Oral and Maxillofacial Surgery. Received D.D.S. in 1981 from the State University of New York at Buffalo, School of Dentistry. In 1986 completed residency program in Oral and Maxillofacial Surgery, University of Rochester, Strong Memorial Hospital. Research focuses on the *in vitro* effects of metals, polymers and ceramics on cells from normal populations and carcinomas.

Dr. J. Malcolm Carter, Associate Professor of Biomaterials. Received Ph.D. in Mechanical Engineering from SUNY-Buffalo 1975 and MSc in Materials Science, Cranfield Institute of Technology, England 1962. Since 1968, has been instructing at SUNY-Buffalo. In 1970 was appointed to the Department of Dental Materials. Studies include *in vivo* electrochemical corrosion of metallic implants utilizing electrolytic methods to dissolve metallic mesh during tissue preparation for histology.

Dr. Laurie C. Carter, Assistant Professor of Stomatology and Interdisciplinary Sciences. Received D.D.S. from the University at Buffalo in 1983, Certificate in Oral Pathology in 1986 and M.A. in Experimental Pathology in 1988. Currently is completing Ph.D. in Experimental Pathology at the University's School of Medicine. Received Individual National Research Service Award from the National Institute of Dental Research from 1984 to 1987. Primary research interest is the study of interfacial aspects of various implant/tissue systems, utilizing both light microscopic and ultrastructural methods.

Dr. Keith E. Cooksey, Professor of Microbiology and Biochemistry, Montana State University. Received Ph.D. in 1959 from the University of Birmingham, England, in Biochemistry and was a postdoctoral fellow of the National Research Council of Canada from 1960 to 1961. In addition to academic appointments, spent 1965-1968 as a Senior Scientist with Shell Research Ltd. in England. Primary research interests are mechanisms of the interactions of cells with surfaces, and algal biotechnology.

Dr. Joseph A. Gardella, Jr., Associate Professor of Chemistry and Co-Director, IUCB. Received Ph.D. from the University of Pittsburgh in Surface Analytical Chemistry (1981), continuing with

postdoctoral research at the University of Utah in 1982. Since 1982, has been on the faculty of the University at Buffalo, pursuing research in the study of thin organic and polymer film interfaces and multicomponent polymer surfaces using electron, ion and vibrational spectroscopies. Professor Gardella was Fellow of the Lawrence Gelb Foundation and is a Fellow of Exxon Education Foundation.

Dr. Robert J. Good, Professor of Chemical Engineering. Received Ph.D. in 1950 from University of Michigan and an M.S. from the University of California, Berkeley, both in Chemistry. Recipient of the Kendall Award for Surface and Colloid Chemistry. Theoretical studies of contact angle measurements include protein solubility, polymer solubility and phase separation, cell membrane fusion, hydrophobic bonding and hydrogen bonding adhesion.

Dr. Gordon A. McFeters, Professor of Microbiology, Montana State University. Received a Ph.D., 1967, in Microbiology from Oregon State University and M.S. from Loma Linda University, 1963, in Microbiology. Performed research at the Swiss Federal Institute for Water Resources and Water Pollution Control, 1987-1988. Research interests include water and wastewater microbiology, physiology of waterborne bacteria, microbial ecology, and biodegradation in soil and groundwater.

Dr. Anne E. Meyer, Principal Research Scientist and Program Manager, IUCB. Received Ph.D. from Lund University (Sweden) in 1990. Was Associate Director of the University's Surface Science Center, 1985-1989 and of the NYS Center for Advanced Technology in Health-care Instruments and Devices. Prior experience was as analytical chemist at Arvin/Calspan (1974-1986), serving as Head of the Advanced Technology Center's Surface Science Section from 1983 to 1986.

Dr. George H. Nancollas, Distinguished Professor of Chemistry. Received Ph.D. from the University of Wales and D.Sc. from the University of Glasgow (1963). Since 1965, has been on the faculty of the University at Buffalo investigating the kinetics of crystallization and dissolution, and the thermodynamics of mineral species in complex environments. Professor Nancollas has been recognized by the American Chemical Society with the 1977 Jacob Schoellkopf Medal and by the International Association for Dental Research with the 1984 Basic Research in Biological Mineralization Award.

Dr. Eli Ruckenstein, Distinguished Professor of Engineering. Joined the University at Buffalo faculty in 1973. Was the Gulf Visiting Professor at Carnegie Mellon University in 1987-1988 and the Visiting Humboldt Professor at Bayreuth University (W. Germany) in 1986, among several other honored positions over the past 20 years. Received the American Chemical Society's Kendall Award for research in colloids and surfaces in 1986 and the Walker Award of the American Institute of Chemical Engineers for Excellence in Contribution to Chemical Engineering Literature in 1988.

Dr. Carel J. van Oss, Professor of Microbiology and Adjunct Professor of Chemical Engineering. Received Ph.D. in Physical Biochemistry from the University of Paris (Sorbonne) in 1955. Before coming to the University at Buffalo in 1968, was Director of the Laboratory of the National Veterinary College of Alfort (Paris), Assistant Head - Microbiology and Immunology Departments of Montefiore Hospital and Medical Center (New York City), Director - Serum, Plasma and Immunochemistry Departments of the Milwaukee Blood Center, and Adjunct Associate Professor of Biology at Marquette University, Milwaukee.

BRIEF DESCRIPTIONS OF FUNDED PROJECTS

Fiber-Optic-Based Characterization of Biosurfaces

Dr. Frank V. Bright

This project is concerned with determining the mechanism and kinetics of protein adsorption and denaturation at surfaces. This work involves continued IUCB-funded efforts toward understanding the fundamental processes that govern adhesion. To this end, we use state-of-the-art fluorescence spectroscopic techniques to study biologically important adsorbates. Specifically, we are focusing on the β -lactoglobulin system and documenting the kinetics of adsorption as a function of temperature, ionic strength, and denaturant. In addition, we are now beginning to actually look at the dynamical aspects of this same protein at an interface.

The PI's group has developed state-of-the-art fiber-optic probes for studying interfaces. The instrumentation and protocols developed by the PI are well suited for investigating steady-state and dynamical processes occurring at "ambient" interfaces.

The Response of Normal and Carcinoma Cells to Implantable Biomaterials

Dr. John H. Campbell

This study investigates the in vitro effects of metals, polymers, and ceramics on cells from normal populations and carcinomas, utilizing biocompatibility and toxicity assays to determine if these materials enhance, inhibit, or have no effect on the cell growth characteristics. Assays utilize specific, well-characterized reference materials of the polymeric, ceramic, and metallic classes provided by the Core Program of the Industry/University Center for Biosurfaces.

The PI is an oral surgeon with postdoctoral training in the techniques of tissue culture for normal and malignant cells. This research is carried out in the Otolaryngology and Head and Neck Center at an affiliated hospital of the University's School of Medicine and Biomedical Sciences.

Comparison of Laboratory Preparative Techniques for the Retention and Characterization of Bone-Implant Interfacial Morphology

Dr. Laurie C. Carter and Dr. J. Malcolm Carter

This study compares the efficacy of two preparatory techniques for implant retrieval analysis: conventional decalcification and removal of the implant prior to sectioning *vs.* thick sectioning and milling of an undecalcified specimen with the fixture still *in situ*. The goal is to retain interfacial structure and deliver precise information regarding macrophagic cells. Osteochrome bone stains and macrophage marker stains, with histomorphometric analysis, will allow more precise measurements of static and dynamic parameters of osseous tissue.

The Co-PI's have substantial prior experience in implant retrieval analysis of a variety of materials implanted in bone, including Co/Cr/Mo alloys, carbonated hydroxyapatites and titanium.

A Study of Adhesion of Fouling Diatoms to Surfaces of Defined Composition Including an Examination of the Source and Role of the Conditioning Film

Dr. Keith E. Cooksey

This project determines which physico-chemical properties of a surface govern the strength and extent of adhesion of diatoms, and examines how the extracellular polymer produced by diatoms is able to modify clean surfaces such that their potential bioadhesive substrata are changed. Adhesion assays use washing procedures with differing shear forces, so that different levels of strength can be measured. Motility assays use a video-recording system fitted with a time signal generator.

Adhesion assays are currently used by the PI to detect differences in surface properties. Motility assays are developed for transparent surfaces. Collaborative studies have been done through

the ONR Molecular Biology Program. Several published papers by the PI on the marine fouling diatom *Amphora collicaeformis* are relevant to this work.

Ultra High Vacuum Surface Analysis of Model Organic and Biological Films on Solid Substrata

Dr. Joseph A. Gardella, Jr.

This project evaluates and describes the molecular and macromolecular composition, structure and bonding of model thin films adsorbed onto clean characterized standard substrata. Thin films of saturated fatty acids, their salts, fibrinogen, β -lactoglobulin, and salivary mucin will be prepared by adsorption from solution using standard flow cells; stable static monomolecular layer films will be produced in Langmuir-Adam troughs. Analysis will include ESCA, Auger, SIMS and FTIR. The emphasis is on the chemistry between the substratum material interface (i.e. oxidation of Ti, hydrolysis of polylactide, RFGD modification of polystyrene) and the model biofilm structure and orientation. For each substratum, we hope to determine the quantitative chemistry which governs the subsequent biofilm character. Modification of the substratum is then possible.

Ongoing research sponsored by NSF, NATO, and Industry has advanced the techniques listed above specifically for the analysis of thin organic (LB) and polymeric films. In addition, ongoing collaborations with laboratories active in development of ambient-environment methods of analysis of solid and biological materials also provide an important base.

A Basic Study of Polymer Surfaces and Biological Surfaces: The Acid/Base and Apolar Components of Surface Free Energy Which are Responsible for Bioadhesion

Dr. Robert J. Good and Dr. Carel J. van Oss

The investigators use contact angle measurements to determine the acidic and basic components, as well as the apolar component, of the surface energies (surface tensions) of polymers, and of proteins and other biological solids. Contact angles are measured using water, glycerol and diiodomethane on a variety of polymer surfaces. These include polyethylene and systematically fluorinated polyethylenes, polydimethylsiloxanes and other silicone polymers, polylactides, polystyrene and surface-modified (glow-discharge treated and chemically treated) polystyrenes, glow-discharge-treated polyethylenes and polypropylene, and pyrolytic carbon. Surface texture of these polymers is studied using SEM and the change in contact angles monitored relative to reference, smooth specimens. Contact angles also are measured on layers of proteins and other biological materials, deposited on support surfaces.

This theory has been espoused in 11 papers in the past 4 years. Some subject areas include protein solubility; polymer solubility and phase separation; cell membrane fusion; hydrophobic bonding; hydrogen bonding in adhesion.

The Physiological Status of Bacteria in Biofilms

Dr. Gordon A. McFeters

This project determines the growth rates of surface-associated and planktonic bacteria, and compares their metabolic activities. Specifically, the levels of catabolic metabolism and respiration in bacterial populations that are surface-associated and planktonic are addressed via measurement of the utilization of specific radiolabeled or density-labeled substrates with respiration determined by oxygen uptake. This provides two different quantitative measures of the differential digestive activities of bacteria in biofilms. Radiolabeled precursors for anabolic processes such as protein and nucleic acid synthesis are used to measure the synthetic activity of bacteria on surfaces and in suspension.

The PI has numerous basic publications in the cited field, and has carried out similar studies in relevant natural environments.

Characterization of "Conditioning" Films by Ambient-Environment
Physico-Chemical Techniques

Dr. Anne E. Meyer

Substratum-dependent "conditioning" film properties are investigated as functions of exposure time, solution components, and fluid dynamics. Model proteins, hyaluronic acid and cell media in contact with reference metallic, ceramic and polymeric substrata are analyzed as bulk films and as Langmuir-Blodgett monolayers. Films are applied in static and dynamic exposure protocols. Determination of average time of effective cell attachment will be correlated with contact angle, multiple attenuated internal reflection IR, energy dispersive X-ray analysis, contact potential, and ellipsometric data.

The PI has established that all engineering materials placed into contact with biological fluids spontaneously acquire organic films on their surfaces. Recent publications show that events during the first few hours of exposure can be predictive of longer term material/biosystem interactions.

Mineralization and Dissolution Kinetics Studies at Plasma-Sprayed
Implant, Ceramic and Immobilized Macromolecular Surfaces

Dr. George H. Nancollas

Constant Composition (CC) kinetics combined with a flow-thru cell in a closed-loop allows excellent sensitivity to extremely small amounts of mineralization with high precision. The mineralized surfaces are characterized using SEM, TEM, EDAX, ESCA, SIMS, Auger, and electron diffraction devices available in the Biomaterials and Chemistry Departments. HAP plasma-coated titanium implants are examined at calcium and phosphate concentrations typical of those *in vivo*.

Using the flow-thru Constant Composition cell, preliminary studies have been made on purified protein films of amylase and cystatins, SA-I and SA-II. The PI is the inventor of the Constant Composition technique, and holds a patent on nonpolluting scale-prevention coatings based on silicones.

New Possible Avenues to Prepare Antifouling Coatings

Dr. Eli Ruckenstein

The aim is to prepare coatings of di-block or three-block copolymers on hydrophobic surfaces, and composite polymers, by an emulsion pathway. Initial experiments are being carried out with polymethylmethacrylate, polystyrene, and polyvinylacetate. Surface examination includes wetting angle as well as surface analytical measurements by ESCA. Antifouling capabilities will be estimated by performing protein adsorption measurement by radiolabeling or ellipsometry techniques, and by platelet deposition experiments using platelet-rich-plasma.

The PI has published information about very low interfacial free energies between solids and environmental liquids. He has specified conditions where the thermodynamic driving force for deposition on the surface is very low.

MANAGEMENT

The Center is directed by Dr. Robert E. Baier and Dr. Joseph A. Gardella, Jr. Dr. Baier has 25 years experience in research related to biological surface phenomena. Dr. Baier is a founding member of the Society for Biomaterials and, in 1983, received the Society's Clemson Award for Basic Research. He has been Principal Investigator on over \$3 million of funded research (and co-investigator on over \$10 million of funded research) for industry and for such federal agencies as National Institutes of Health and Department of Defense. Since joining the University at Buffalo in 1984, Dr. Baier has been instrumental in forging cooperation, communication, and working relationships among related technology centers. This led to additional New York State and industrial support of the University of approximately \$3 million per year, through the Center for Advanced Technology that he directed at Buffalo from 1985 to 1989.

Dr. Gardella has 12 years experience in biomaterials surface research and was instrumental in establishing the interdisciplinary network of faculty that forms the basis of the Center's research program. Dr. Gardella is a pioneer in the analysis of Langmuir-Blodgett films (monolayers and multilayers) and polymers by ultra-high vacuum techniques such as static secondary ion mass spectrometry and electron spectroscopy for chemical analysis. He also has been the driving force in the University's acquisition of state-of-the art surface analytical equipment utilized by the Center.

Dr. Anne E. Meyer, Program Manager,

brings 12 years of prior industry research management experience to the Center, including serving as Head of the Surface Science Section for a major, independent contract research firm.

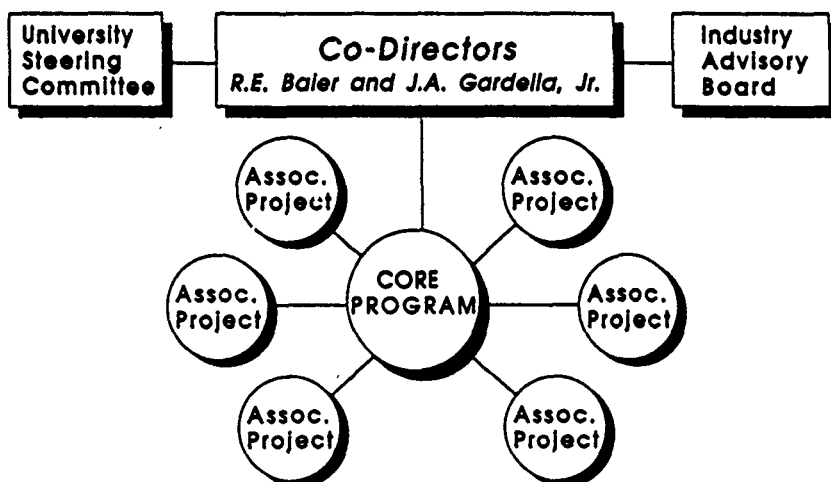
CENTER EVALUATOR

The Evaluator is a compensated representative of the larger Industry/University Cooperative Research Center Program of the National Science Foundation, and as such participates in two Capitol-area conferences with nation-wide professional colleagues each year to develop increased benefits for all Center Members.

The Evaluator always is available to the Center managers and to Advisory Board Members to help implement improvements to the Center organization, communication, and planning.

Mr. Edward M. Zablocki, a professional in industry relations, serves as the formal NSF-recognized on-site Evaluator for the Industry/University Center for Biosurfaces. As Evaluator, Mr. Zablocki mainly utilizes interview and questionnaire techniques to assess the Center's effectiveness in achieving Member and University goals. He serves most generally as an "ombudsman" for the Members, assuring prompt attention to Members' needs in spite of the competing demands usually made for faculty time and attention.

ORGANIZATION OF IUCB RESEARCH PROGRAM



INTELLECTUAL PROPERTY

Center patents are generally shared on a royalty-free basis by Center Members, although exclusive rights are also available in accord with the patent policy stated in the Research Agreement.

The Center *budgets* a specific amount each year to *pursue patents* at the direction of the Advisory Board. Inventions made with support from federal agencies are subject to the provisions of Public Law 95-517 and its implementing regulations (OMB Circular A-124).

PRIVILEGED ACCESS TO NEW DATA

The University and associated faculty provide Advisory Board Members with a pre-submission review period for all Center-developed research data used in manuscripts or other public presentations.

The advance review period allows for isolation of potentially patent-worthy or proprietary elements. Recognizing the usual delay in publication cycles, Advisory Board Members generally have knowledge of research results 18 months prior to access by the general public. The specific publication policy is part of the Research Agreement.

Title to all copyrightable material is held by the Research Foundation of the State University of New York at Buffalo. The Research Foundation grants to Advisory Board Members, upon request, royalty-free licenses to use copyrightable materials developed as part of the Center's research program.

Member-appointed technical monitors are invited to follow Project progress on a real-time basis, and a generous program of personnel exchange between Member and University laboratories facilitates rapid technology transfer.

Window on Broad but Related Technologies

Review of related patents generated University-wide

Seminar Series

Publications, lists of student theses and recent Ph.D. students of Center Faculty



FINANCIAL LEVERAGING

The Center provides significant leveraging of each Member's contribution.

The National Science Foundation grants at least \$75,000 per year for the first 5 years of the Center's operation to fund Center administration and evaluation costs, as well as Core Program activities.

Members each contribute a \$40,000 annual fee, entirely devoted to support of the research activities of the Center as recommended by the Members Advisory Board.

The University at Buffalo waives all but the State-mandated minimum overhead costs (approximately 14%).

Additional Research Development funds of approximately \$190,000 for the first two years of Center operation were committed by the University at Buffalo.

The University at Buffalo also purchased more than \$3 million of new, state-of-the-art analytical equipment, housed in new laboratories dedicated to this Center's field of research. The cooperating Montana State University provides complementary facilities developed under prior National Science Foundation grants.

Through the New York State Science and Technology Foundation, there has been an additional investment of approximately \$400,000 that could continue in a new State/NSF Center initiative now under review.

The Industry/University Cooperative Research Center for Biosurfaces provides this leveraging of each Industry/Agency Member's contribution while maintaining all Members' rights to newly developed intellectual property.

PRIORITY STATUS FOR "COMMERCIAL CONFIDENTIAL" PROJECTS

Member industries receive highest priority attention for commercial confidential projects.

The Center, through its faculty and personnel, has recently completed projects in related areas:

- Surface characterization of metals, ceramics and plastics
- Surface modification of polymers
- Evaluation of implant biocompatibility
- Mineral scale formation in industrial processes
- Development of fiber optic sensors
- Certification of new sterilization processes
- Definition of materials resistant to biocorrosion
- Control of biofouling

TAX BENEFITS

The National Science Foundation-sponsored Industry/University Cooperative Research Center (IUCRC) Program specifically qualifies for favorable tax treatment.

The Basic Research Credit applies at a significantly higher rate than the R & D Tax Credit for contractual research. Companies are able to claim the credit for basic research even though they enter into an agreement that reserves significant rights to any resulting technology to the company.

**The Industry/University Center for Biosurfaces
benefits its Membership through fundamental,
focused research projects,
new employee development, patent rights,
pre-submission review of publications,
and a high level of financial leveraging.**

Additional Members are welcome!

**For a copy of the Research Agreement
and additional information, please contact**

**Ms. Susan M. Arnold
Industry/University Center for Biosurfaces
State University of New York at Buffalo
110 Parker Hall
Buffalo, NY 14214
Telephone: (716) 831-3560
Telefax: (716) 835-4872**



Appendix F. Regarding the Use of Human Subjects and Laboratory Animals in this Research Program

HUMAN SUBJECTS

This is a research grant proposal for which plans for inclusion of human subjects are not definite. A certification of Institutional Review Board (IRB) review and approval of research involving human subjects will be provided before the activity begins if certification has not already been filed.

The State University of New York at Buffalo has an approved assurance of compliance on file with HHS which covers this activity (assurance identification number: M-1270; IRB identification number: -01).

LABORATORY (VERTEBRATE) ANIMALS

This is a research grant proposal for which plans for the use of vertebrate animals are not definite. It is likely that some projects will require the use of laboratory animals and will require approval of the University's Laboratory Animal Care Committee prior to any implantation or other surgical procedures. When the specific projects are identified, verification of the dates of the Committee's approvals will be submitted immediately to the appropriate monitoring office.

The Laboratory Animal Care Committee of the State University of New York at Buffalo operates under an approved Animal Welfare Assurance (identification number: A3354-01).

Robert E. Baier
Joseph A. Gardella, Jr.

<u>Agency</u>	<u>Title</u>	<u>Total Cost (Direct Cost) (Annual Rate)</u>	<u>Period Covered by Award</u>	<u>Percent Effort</u>	
				<u>ACAD</u>	<u>SUMM</u>
<u>Current Support</u> NSF IUCRC Engineering	Industry/University Cooperative Research Center for Biosurfaces	\$80,000 80,000 80,000	09/01/88-08/31/93		
	R.E. Baier, Co-PI	75,000		5	5
	J.A. Gardella, Jr., Co-PI	75,000		5	5
ONR Oceanic Biology	Core Scientific Effort for Biosurface Studies (Task 1)	40,000 40,000 40,000	07/01/88-12/31/91		
	R.E. Baier, Co-PI			5	5
	J.A. Gardella, Jr., Co-PI			5	5
GIBCO, Becton Dickinson, Procter and Gamble	Industry Membership Supplement for Industry University Center for Biosurfaces	120,000	02/01/91-01/31/92		
	R.E. Baier, Co-PI			5	5
	J.A. Gardella, Jr., Co-PI			5	5
American Cyanamid, GIBCO, Nobelpharma USA, Procter and Gamble	Industry Membership Supplement for Industry University Center for Biosurfaces	160,000	02/15/90-06/30/91		
	R.E. Baier, Co-PI			5	5
	J.A. Gardella, Jr., Co-PI			5	5
<u>Pending</u>					
Various Companies (IUCB Membership)	American Cyanamid, Bausch and Lomb, Rich Products, R.E. Baier, Co-PI J.A. Gardella, Jr., Co-PI	(3 companies @ \$40,000)	01/01/91-12/31/92	-	-

Agency	Title	Total Cost (Direct Cost) (Annual Rate)	Period Covered by Award	ACAD	Percent Effort	SUMM
R.E. Baier						
ONR Oceanic Biology	Core Scientific Effort for Biosurface Studies (Task 2)	120,000	06/01/89-12/31/91			
	R.E. Baier, Co-PI			5	5	
	A.E. Meyer, Co-PI			5	5	
New York Sea Grant	Nonpolluting Control of Biosurface Fouling	47,741	09/01/91-08/31/93	-	-	2
	R.E. Baier, Co-PI					
	A.E. Meyer, Co-PI					
Niagara Mohawk Power Corporation	Control of Zebra Mussels: NonToxic Foul-Release Coatings	105,213	07/01/91-06/30/96	-	-	1
	R.E. Baier, Co-PI					
	A.E. Meyer, Co-PI					
Various Companies	(Targeted Research)	50,000	(various)	5	5	
NSF IUCB	Substratum-Induced "Conditioning" Film Changes as Revealed by Thin-Layer Immunoassay	40,000	02/01/91-01/31/92	-	-	
JA Gardella, Jr						
NSF DMR Polymers Program	Ion Beam and Surface Analytical Studies of Macromolecular Surfaces (awarded Two Year Extension for Special Creativity - 1991-1993)	159,600	04/01/91-03/31/93	3	3	70
	J.A. Gardella, Jr., PI					
NATO	Sampling Depth in Model Polymers by Electron and Ion Spectroscopies	11,000	09/01/88-08/31/92	3	3	3
	J.A. Gardella, Jr., PI					
	J.J. Pireaux, University of Notre Dame de la Paix, Namur, Belgium, Co-PI					

<u>Agency</u>	<u>Title</u>	<u>Total Cost (Direct Cost) (Annual Rate)</u>	<u>Period Covered by Award</u>	<u>ACAD</u>	<u>Percent Effort</u>	<u>SUMM</u>
IUCB Industry	Ultra High Vacuum Surface Analysis of Model Organic and Biological Films on Solid Substrata	85,000	02/15/90-06/30/92	-	-	-
Exxon Education Foundation	Characterization of Polymer Surfaces: Research and Training Grant Program	20,000	10/05/89-10/01/91	-	-	-
CAT-HIDI	Alternative Substrata for Fiber-Optic-Based Immunosensors F.V. Bright, Co-PI	15,000	02/01/90-08/31/91	-	-	-
<u>Pending</u>						
National Institutes of Health	Advanced Substrata for Fiber-Optic Immunosensors F.V. Bright, Co-PI J.A. Gardella, Jr., Co-PI	51,864	07/01/91-06/30/92	-	-	-

Appendix H. Proposed Budget/Years 4, 5, 6

Industry/University Center for Biosurfaces (University at Buffalo)

Project: Core Scientific Effort for Biosurface Studies - TASK 1
 Sponsor: Office of Naval Research

BUDGET SUMMARY, by Cost Category and Year

	<u>Year 4</u>		<u>Year 5</u>		<u>Year 6</u>		<u>Total</u>
	LOE	\$	LOE	\$	LOE	\$	
<u>Personnel</u>							
Principal Investigator (R. Baier)	3%	-	3%	-	3%	-	-
Co-Princ. Investigator (J. Gardella)	3%	-	3%	-	3%	-	-
Sr. Res. Support Spec. (G. Jones)	25%	\$9668	25%	\$10103	25%	\$10558	\$30329
Res. Support Specialist (J. Earle)	25%	\$7350	25%	\$7681	25%	\$8027	\$23058
Fringe Benefits (27%)		\$4595		\$4802		\$5018	\$14415
Graduate Research Assistant		Note*		Note*		Note*	
TOTAL PERSONNEL		\$21613		\$22586		\$23603	\$67802
<u>Other Than Personnel</u>							
Materials and Supplies		\$1842		\$1609		\$1092	\$4543
Instrument Usage		\$4231		\$3103		\$2340	\$9674
TOTAL OTP		\$6073		\$4712		\$3432	\$17649
INDIRECT COSTS (52.5%) MTDC		\$12314		\$12702		\$12965	\$37981
TOTAL COSTS		\$40000		\$40000		\$40000	\$120000

NOTE: 100% LOE based on 40-hr week (2080 hr/year); salary increases are estimated at 4.5% per year (fringe benefits rate remains constant)

Note*: The University at Buffalo will contribute \$5528 per year for the support of a graduate research assistant assigned to this project.

MTDC = Salary, fringe, travel, supplies and consultant costs.

INDUSTRY/UNIVERSITY CENTER FOR BIOSURFACES - TOTAL PROJECTED BUDGET FOR 1991/92

Projected Expenditures	Total Expenditures	Amounts expected from funding sources			
		OMR	SUMY at Buffalo	Members and NSF	Add-on and Service
I. Personnel (% FTE)					
Co-PI (R. Baier) (.23)					
Co-PI (J. Gardella, Jr.) (.23)		Costshare		Costshare ¹	
Admin. Asst. (S. Arnold) (1.0)	28,942	Costshare	14,471	14,471 ¹	
Evaluator (E. Zablocki) (.10)	5,000			5,000 ¹	
Secretary I (to be named) (.50)	8,000		4,000	4,000 ¹	
Senior Technician (G. Jones) (1.0)	38,674	9,668			29,006 ³
Research Technician (J. Earle) (1.0)	29,400	7,350			22,050
NSF Undergraduate (F. Archer) (.50)	4,488			4,488 ¹	
Graduate Assistant (Core Program)	8,000		8,000 ²		
Fringe Benefits (27%)	29,704	4,595	4,987	6,337	13,785
II. Equipment					
III. OTPS (Specify)					
Materials and Supplies	7,947	1,842	2,286	3,819	
Instrument Usage	19,231	4,231	15,000		
IV. Travel	4,000		2,000	2,000 ¹	
V. Other					
Prospectus	1,500			1,500 ¹	
RUI/PUI (Dr. Kumlér)	17,270			17,270 ¹	
Subcontract MSU	22,442			22,442 ¹	
VI. INDIRECT COSTS ON ABOVE	50,871	12,314		10,157	28,400

Projected Expenditures	Total Expenditures	Amounts expected from funding sources				
		ONR	SUNY at Buffalo	Members and NSF	Add-on and Service	
IUCB Research Projects						
Robert Baier, PI	40,000			40,000 ⁴		
Frank Bright, PI	45,000			45,000 ⁴		
Jack Campbell, Co-PI/Anne Meyer, Co-PI	55,512		7,756	47,756 ^{1,4}		
Joseph Gardella, Jr., PI	45,000			45,000 ⁴		
James Garvey, Co-PI/George Nancollas Co-PI, and others	20,000		20,000			
Robert Good, Co-PI/Ross Giese, Co-PI/ Carel van Oss, Co-PI and others	20,000		20,000			
Joseph Merrick, PI	30,000		30,000			
George Nancollas, PI	50,000			50,000 ⁴		
To be determined through RFP process ⁵	92,500		12,500	80,000 ⁵		
TOTALS:	674,972	40,000	141,000	399,240		93,241

1. National Science Foundation
2. Graduate Research Assistant to be assigned to ONR/Task 1 program
3. Service and Facility Account
4. Industry (Members Advisory Board)
5. Additional investigators are expected to join the program early in February 1992, as a result of review/approval of proposals in January 1992; the figures given are for the first 6 months of CY 1992 only; support for these projects will come from new members